The potential for vector borne infections in the Nordic area now and in the future

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The potential for vector borne infections in the Nordic area now and in the future

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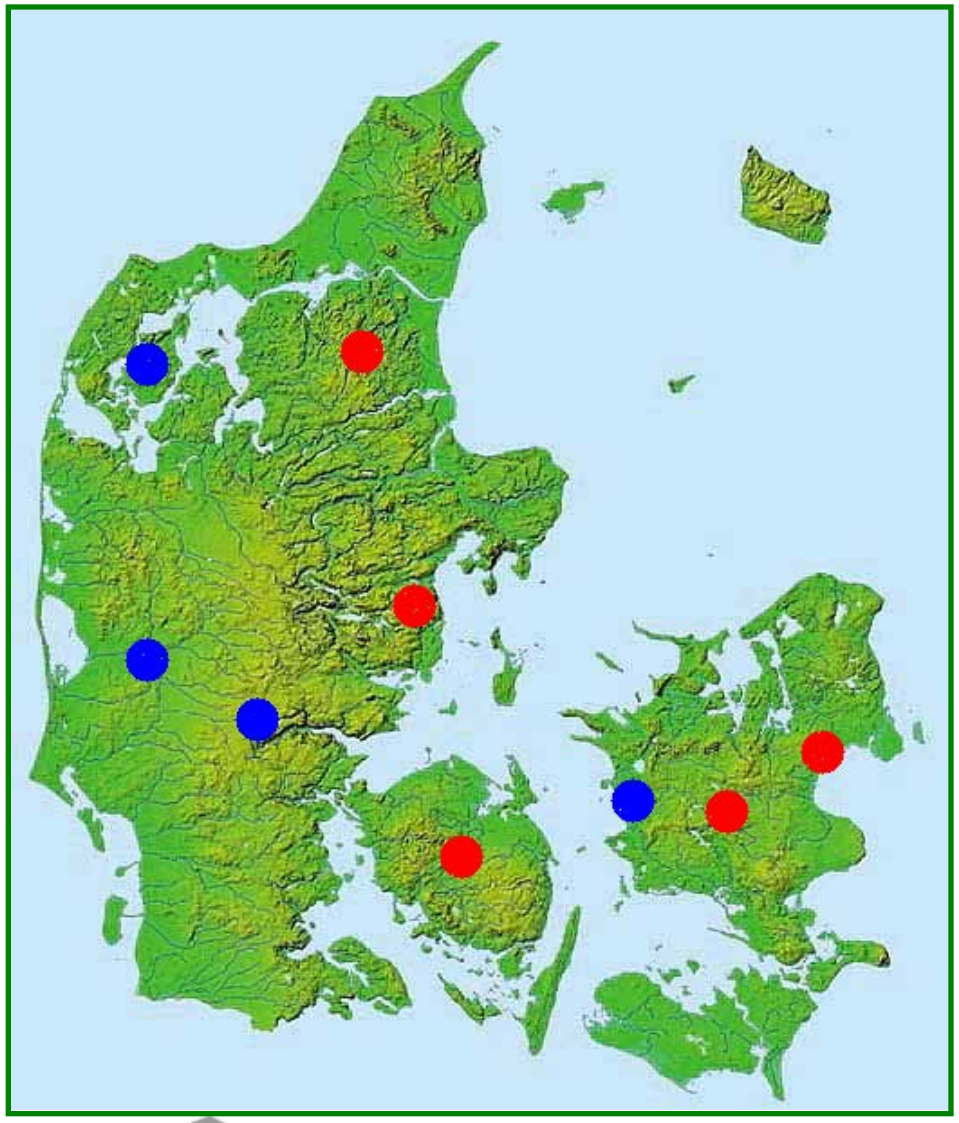
Nalmul Haider

DTU
National Veterinary Institute

Workshop on mosquitoes and biting midges
Trondheim 13-14 June 2016

www.myggetal.dk



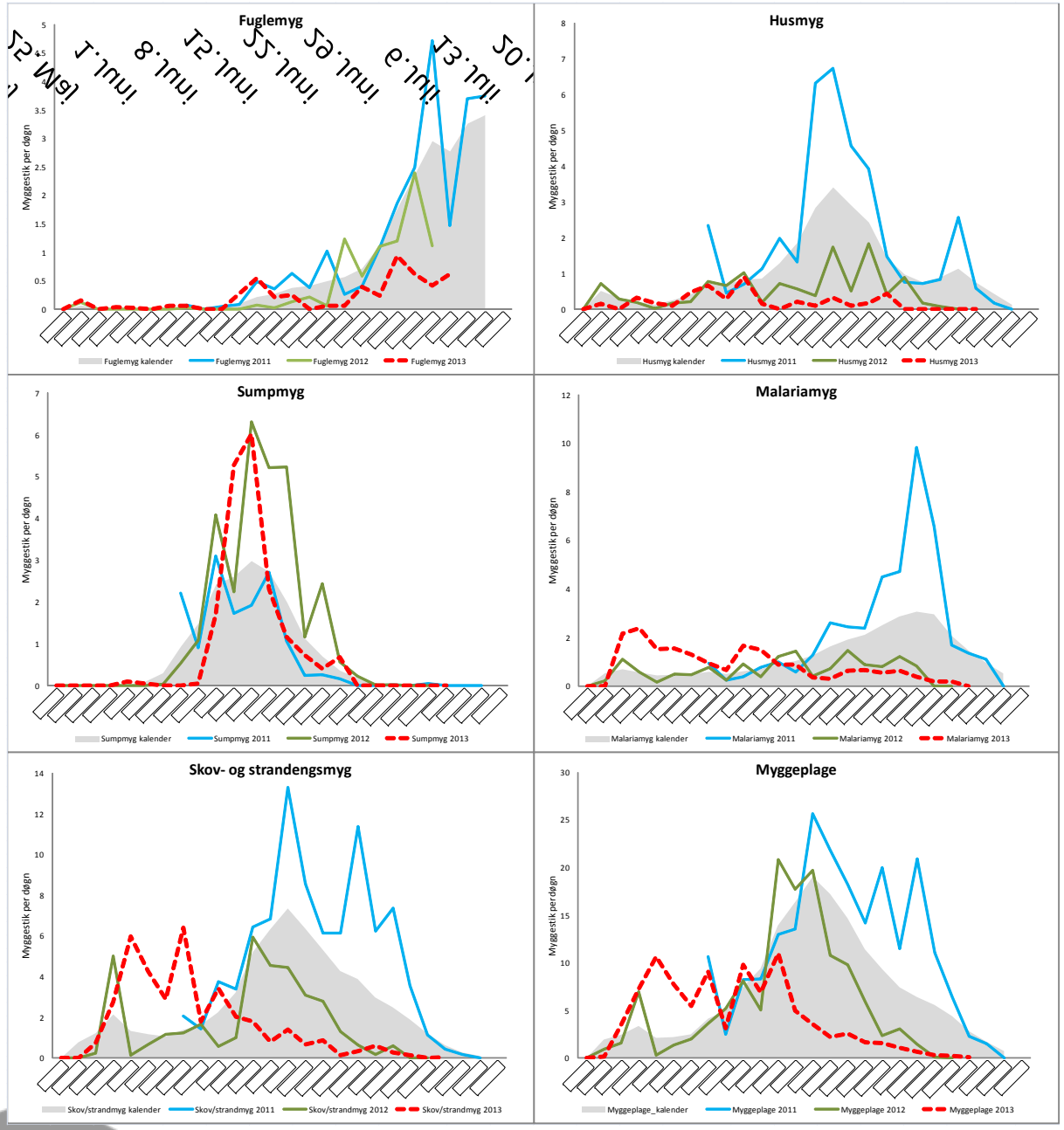
Weekly vector data are freely available on the internet

Weekly surveillance:

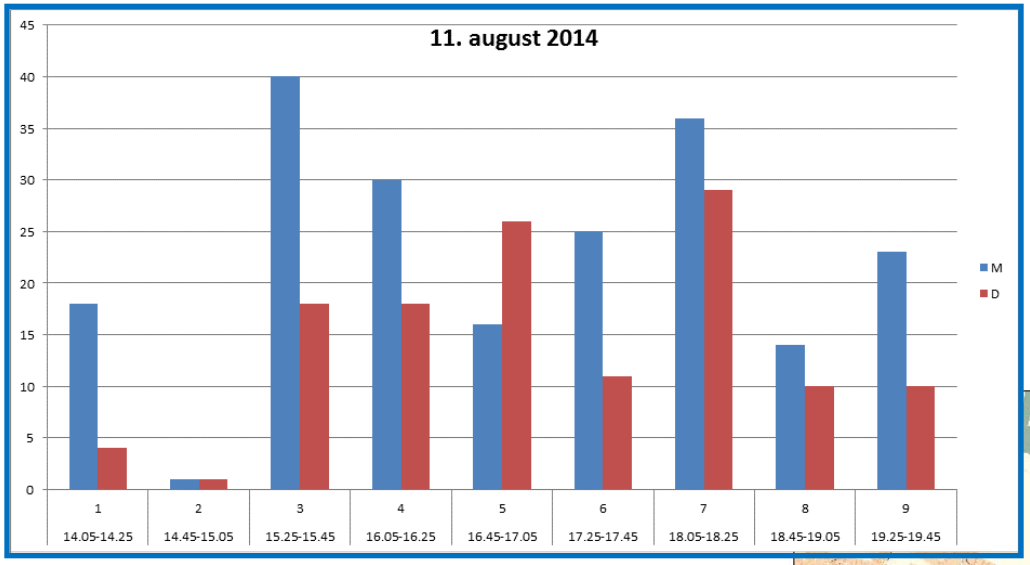
Mosquitoes at 5 sites

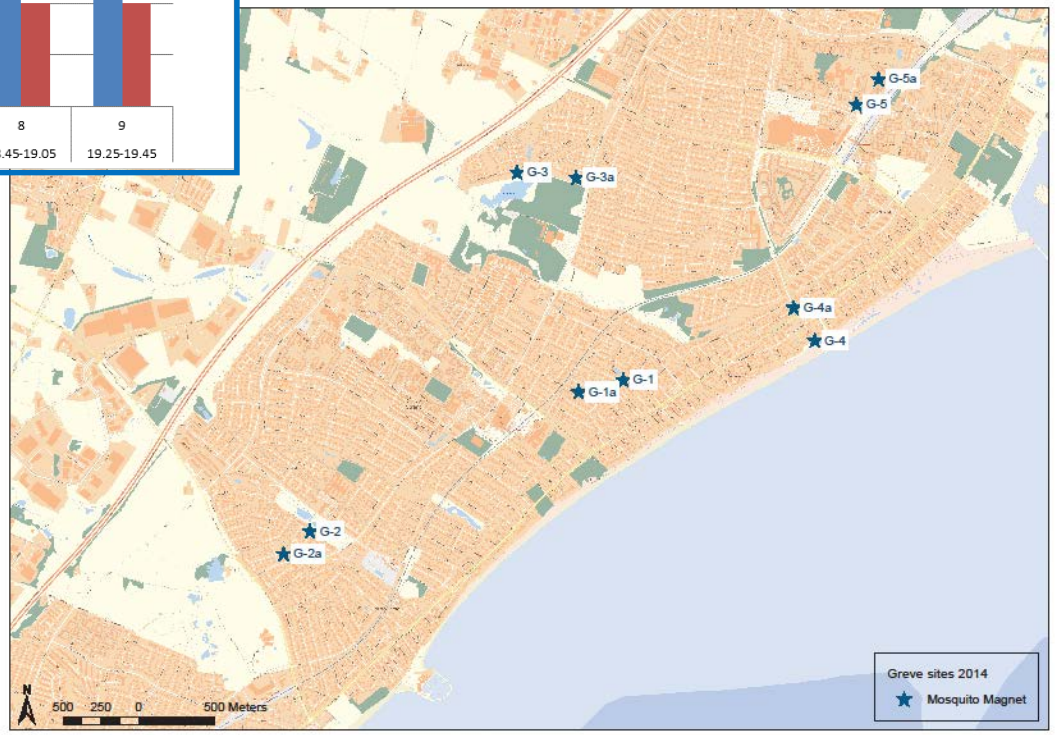
Biting midges at 4 sites

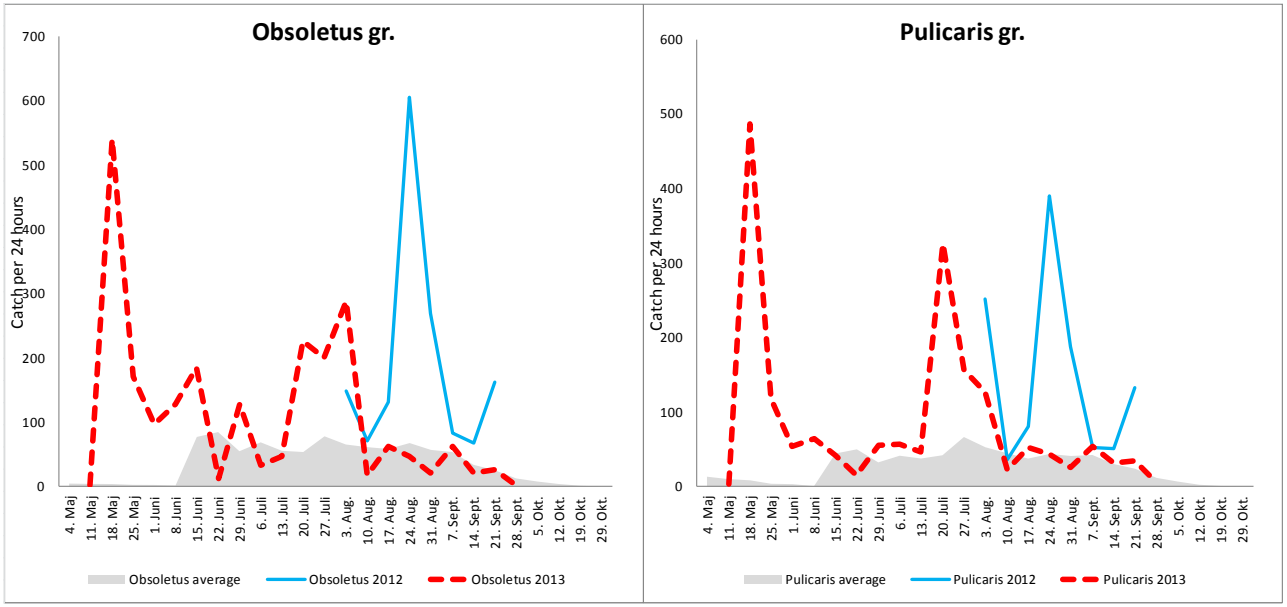
Supplemented by additional surveys


Fuglemyg
Myggestik per døgn
Fuglemyg kalender
Fuglemyg 2011
Fuglemyg 2012
Fuglemyg 2013
Husmyg
Myggestik per døgn
Husmyg kalender
Husmyg 2011
Husmyg 2012
Husmyg 2013
Sumpmyg
Myggestik per døgn
Sumpmyg kalender
Sumpmyg 2011
Sumpmyg 2012
Sumpmyg 2013
Malariamyg
Myggestik per døgn
Malariamyg kalender
Malariamyg 2011
Malariamyg 2012
Malariamyg 2013
Skov- og strandengsmyg
Myggestik per døgn
Skov/strandmyg kalender
Skov/strandmyg 2011
Skov/strandmyg 2012
Skov/strandmyg 2013
Myggeplage
Myggestik per døgn
Myggeplage_kalender
Myggeplage 2011
Myggeplage 2012
Myggeplage 2013

Exotic mosquitoes
Culex modestus

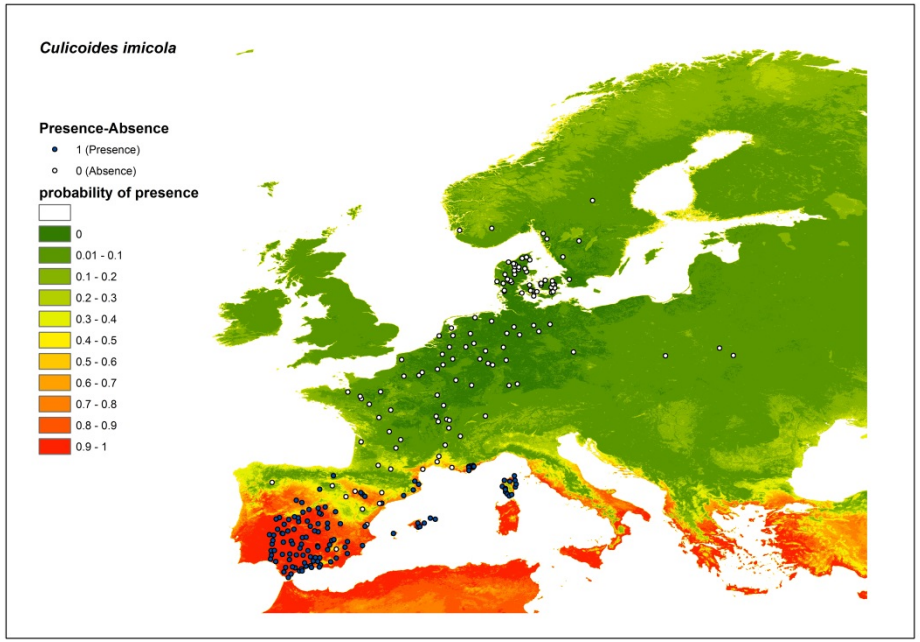




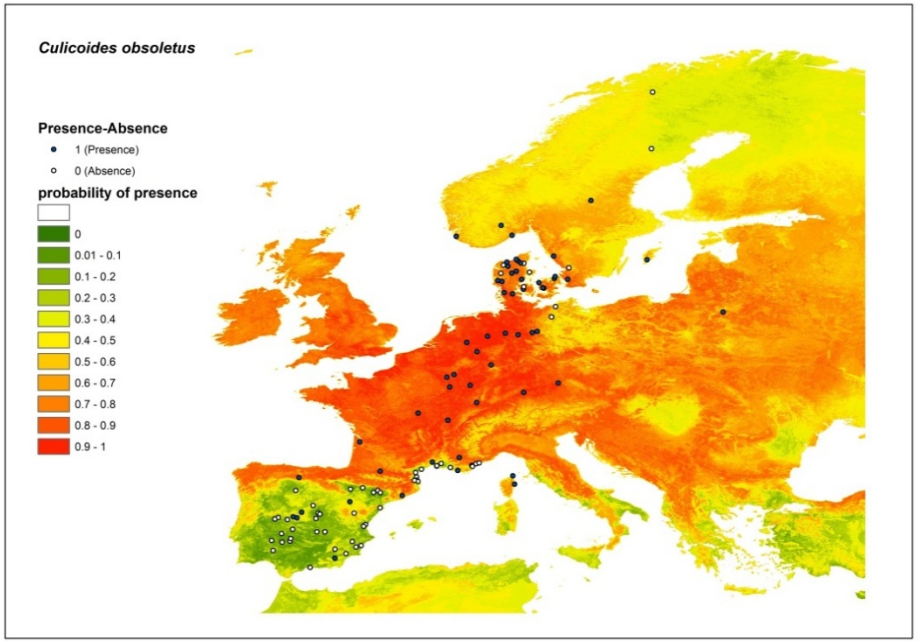

Obsoletus gr.
Catch per 24 hours
700
600
500
400
300
200
100
0
4. Maj
11. Maj
18. Maj
25. Maj
1. Juni
8. Juni
15. Juni
22. Juni
29. Juni
6. Juli
13. Juli
20. Juli
27. Juli
3. Aug.
10. Aug.
17. Aug.
24. Aug.
31. Aug.
7. Sept.
14. Sept.
21. Sept.
28. Sept.
5. Okt.
12. Okt.
19. Okt.
29. Okt.
Obsoletus average
Obsoletus 2012
Obsoletus 2013
Pulicaris gr.
Catch per 24 hours
600
500
400
300
200
100
0
4. Maj
11. Maj
18. Maj
25. Maj
1. Juni
8. Juni
15. Juni
22. Juni
29. Juni
6. Juli
13. Juli
20. Juli
27. Juli
3. Aug.
10. Aug.
17. Aug.
24. Aug.
31. Aug.
7. Sept.
14. Sept.
21. Sept.
28. Sept.
5. Okt.
12. Okt.
19. Okt.
29. Okt.
Pulicaris average
Pulicaris 2012
Pulicaris 2013

Presence / Absence (probability of presence)

C. imicola



C. obsoletus



Vector mapping in VectorNet (EFSA and ECDC)

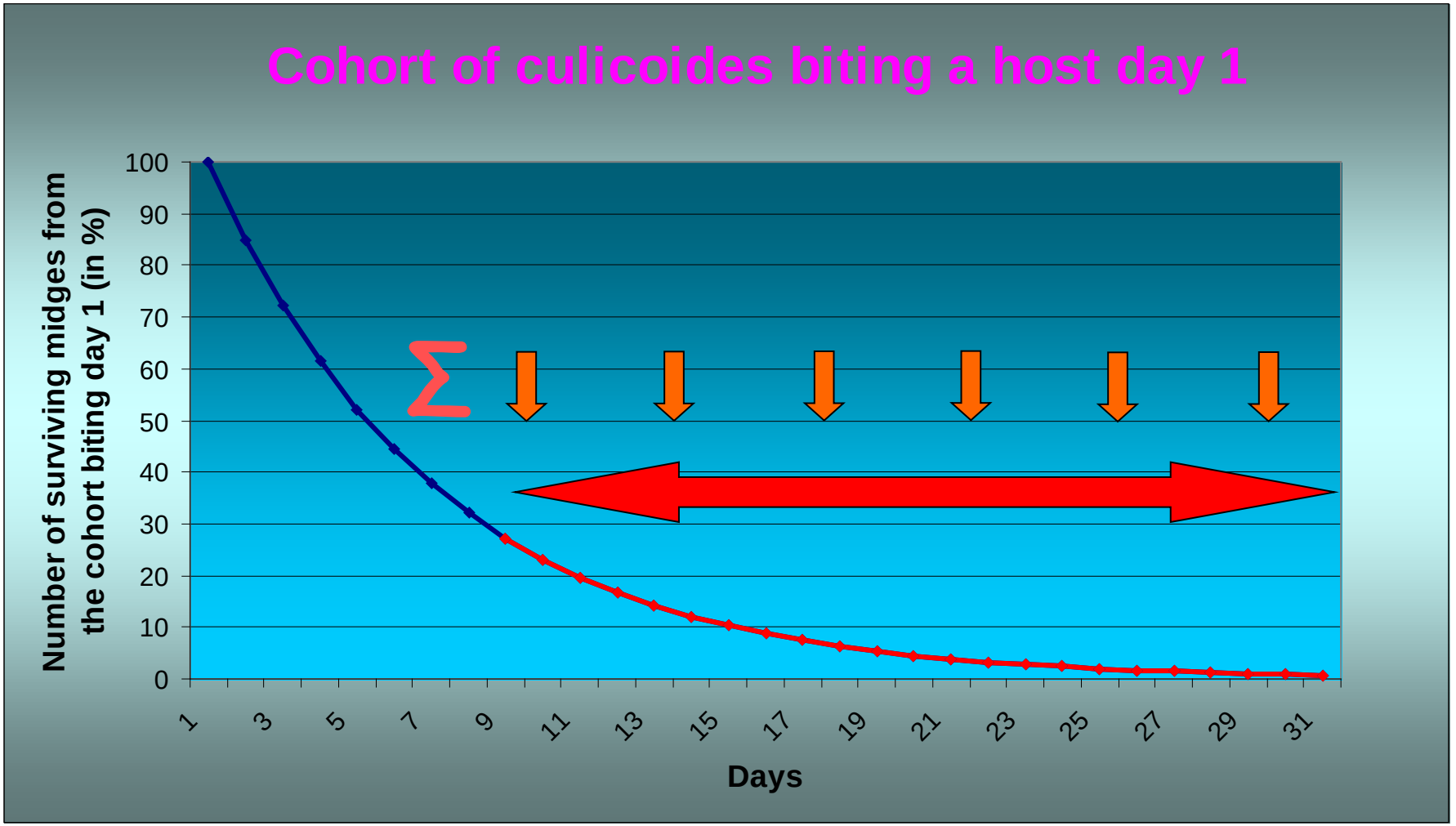
In 2015: Norway, UK, Greenland and Finland.

In 2016: Latvia, Poland, Ukraine and further down

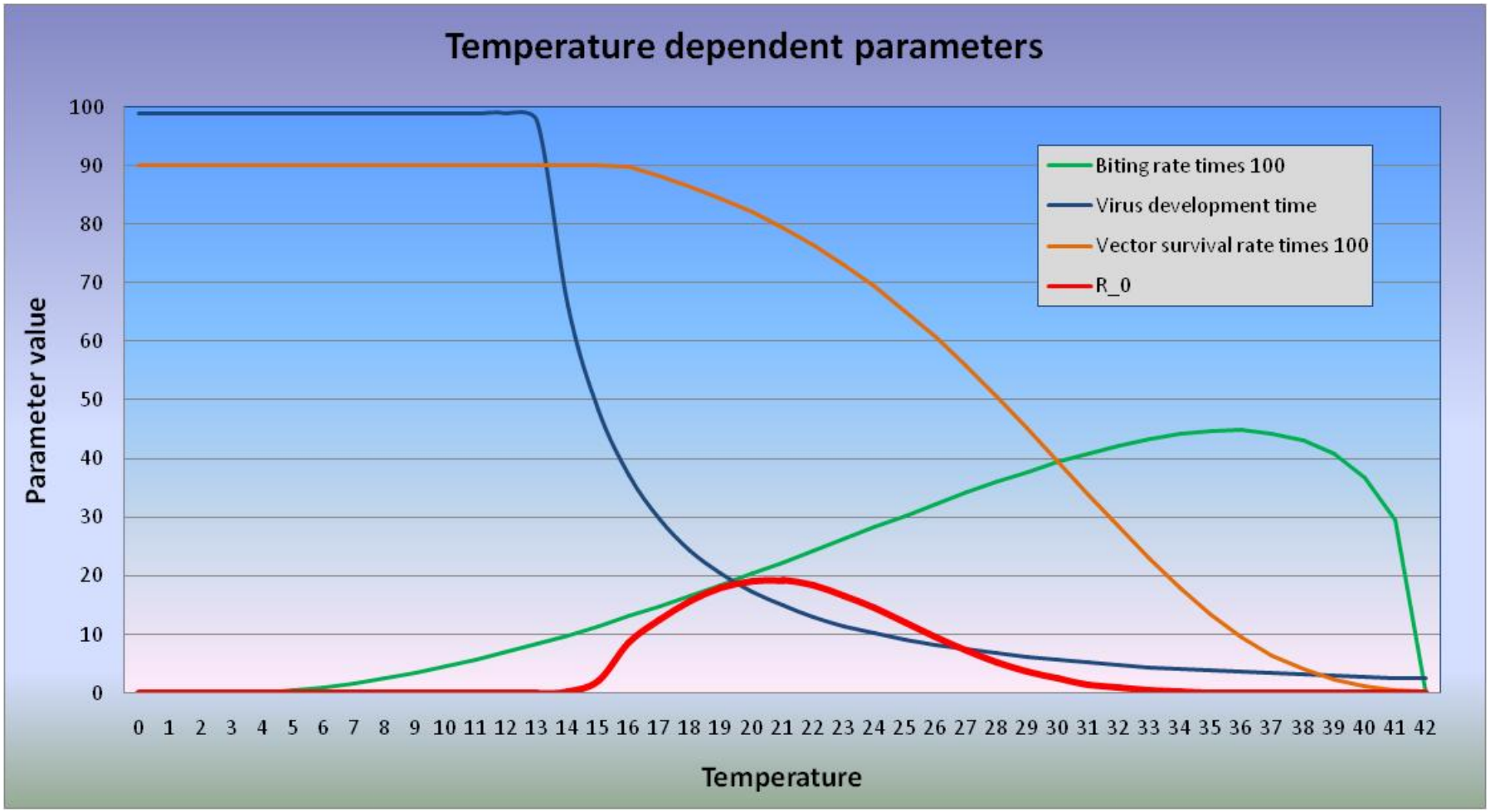
Parameterisation of insect model

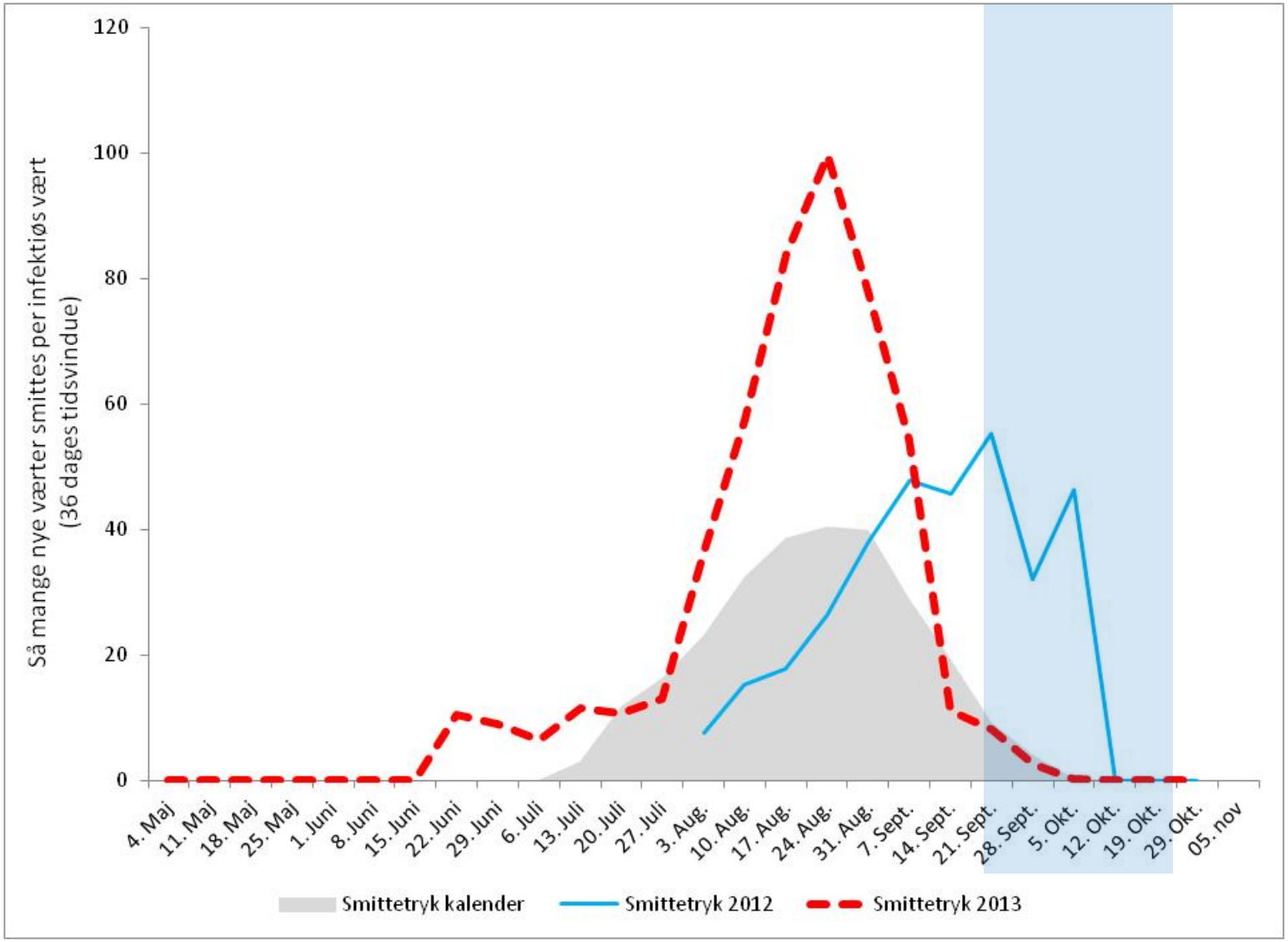
Drivers:	Model parameters:
Environment	Number of insect vectors
Temperature	How often the vector bites
	How long it takes for the virus to develop in the vectors
	The vectors daily survival rate (how long they live)
Disease specific	How long a host is infectious to the vectors
	The probability of transmission from an infectious host to a vector
	The probability of transmission from an infectious vector to a host

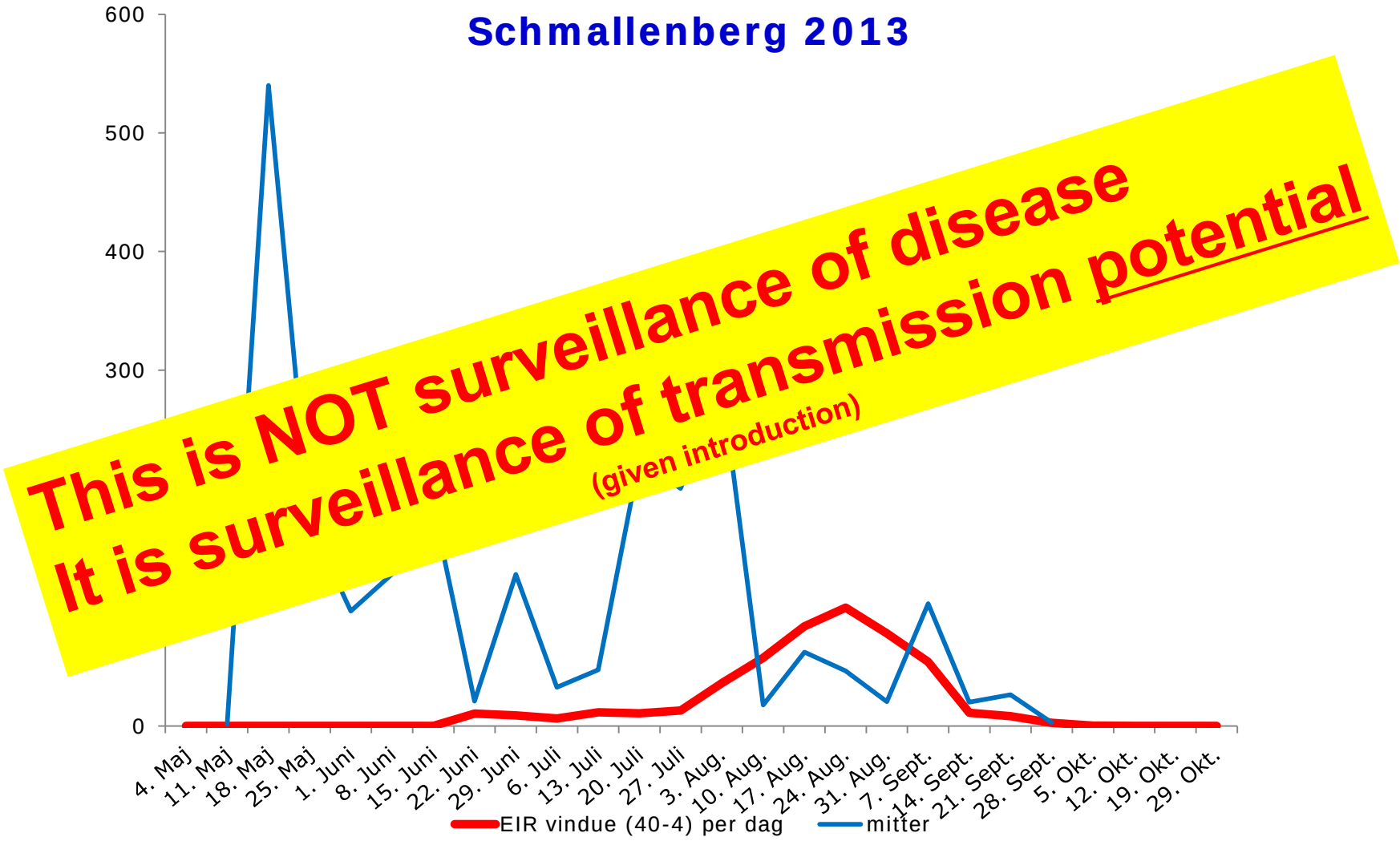
Basic transmission parameters



Basic transmission parameters

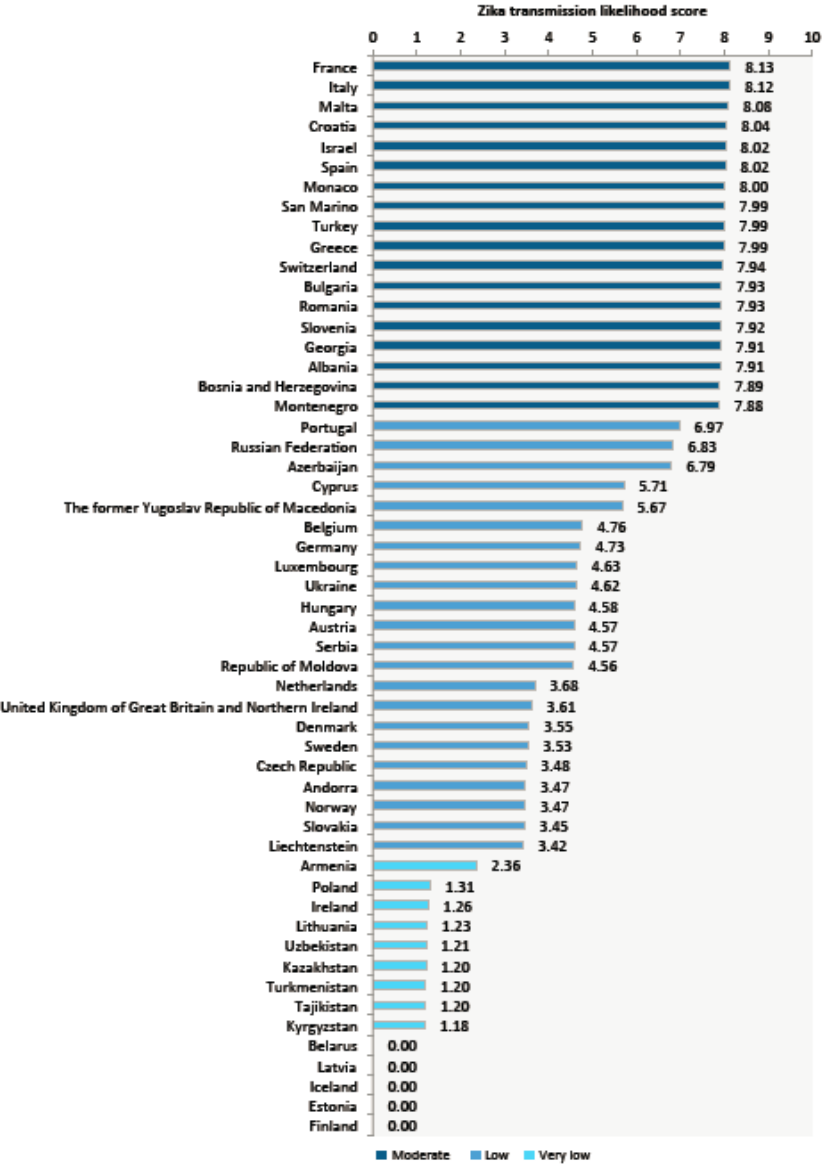



Så mange nye værter smittes per infektiøs vært
(36 dages tidsvindue)
120
100
80
60
40
20
0
4. Maj
11. Maj
18. Maj
25. Maj
1. Juni
8. Juni
15. Juni
22. Juni
29. Juni
6. Juli
13. Juli
20. Juli
27. Juli
3. Aug.
10. Aug.
17. Aug.
24. Aug.
31. Aug.
7. Sept.
14. Sept.
21. Sept.
28. Sept.
5. Okt.
12. Okt.
19. Okt.
29. Okt.
05. nov
Smittetryk kalender
Smittetryk 2012
Smittetryk 2013



This is NOT surveillance of disease
It is surveillance of transmission potential
(given introduction)

Zika virus in Europe 2016



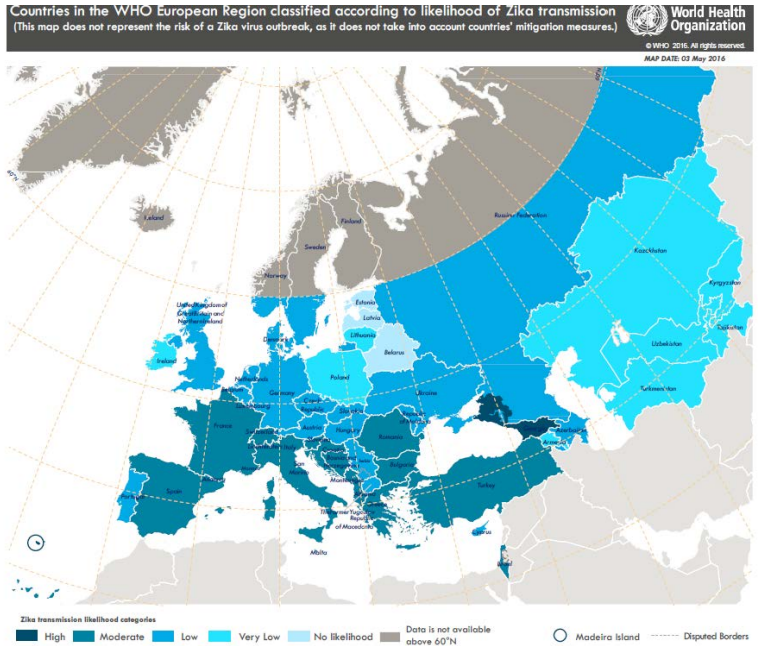
Vector abundance data replaced by teoretic probability for vector presence / absence

The only transmission parameter is vector competence

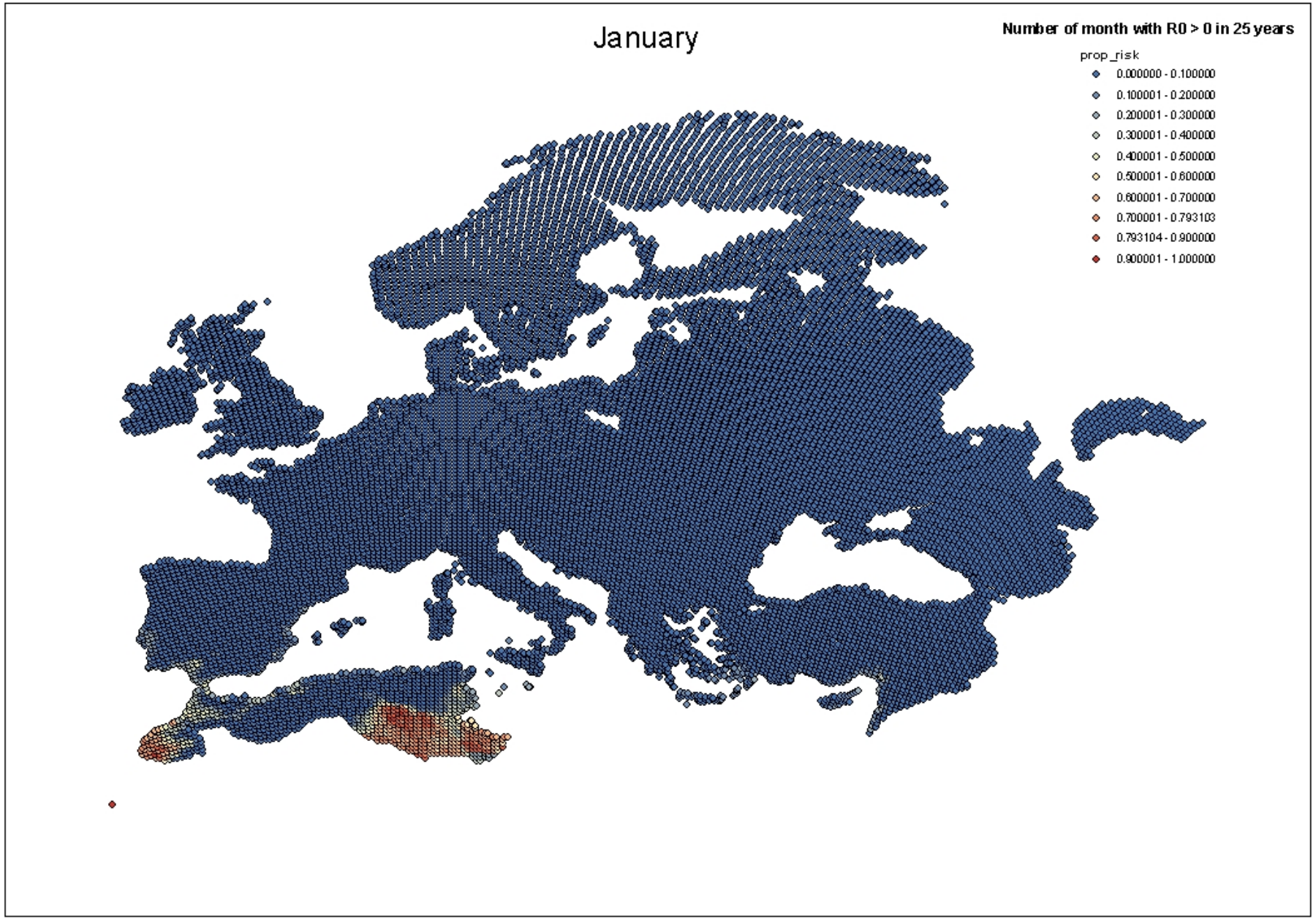
No native mosquitoes included

No temperature

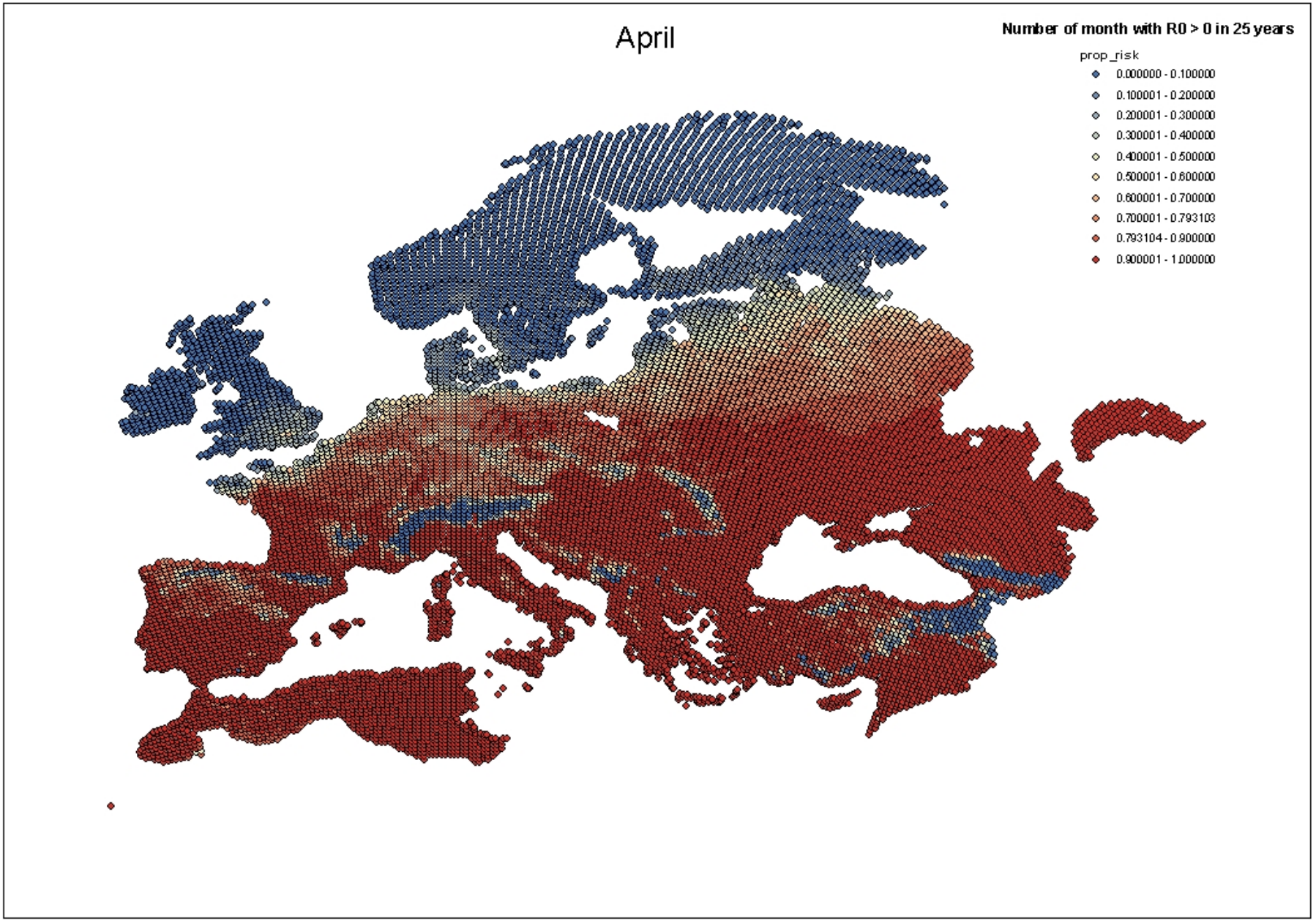
= a score (likelihood of transmission) with two decimals



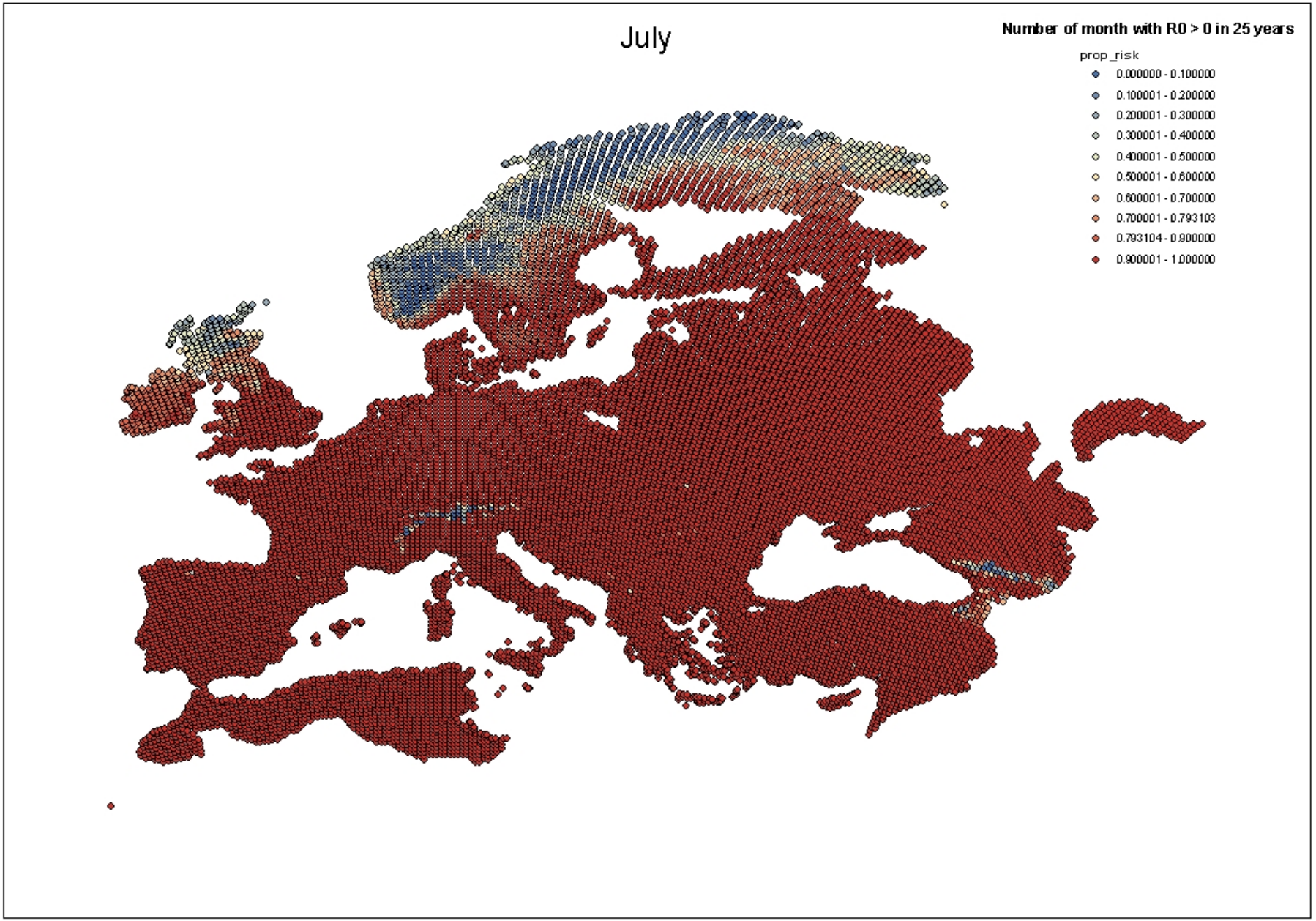
Predicting risk by surveillance of risk factors



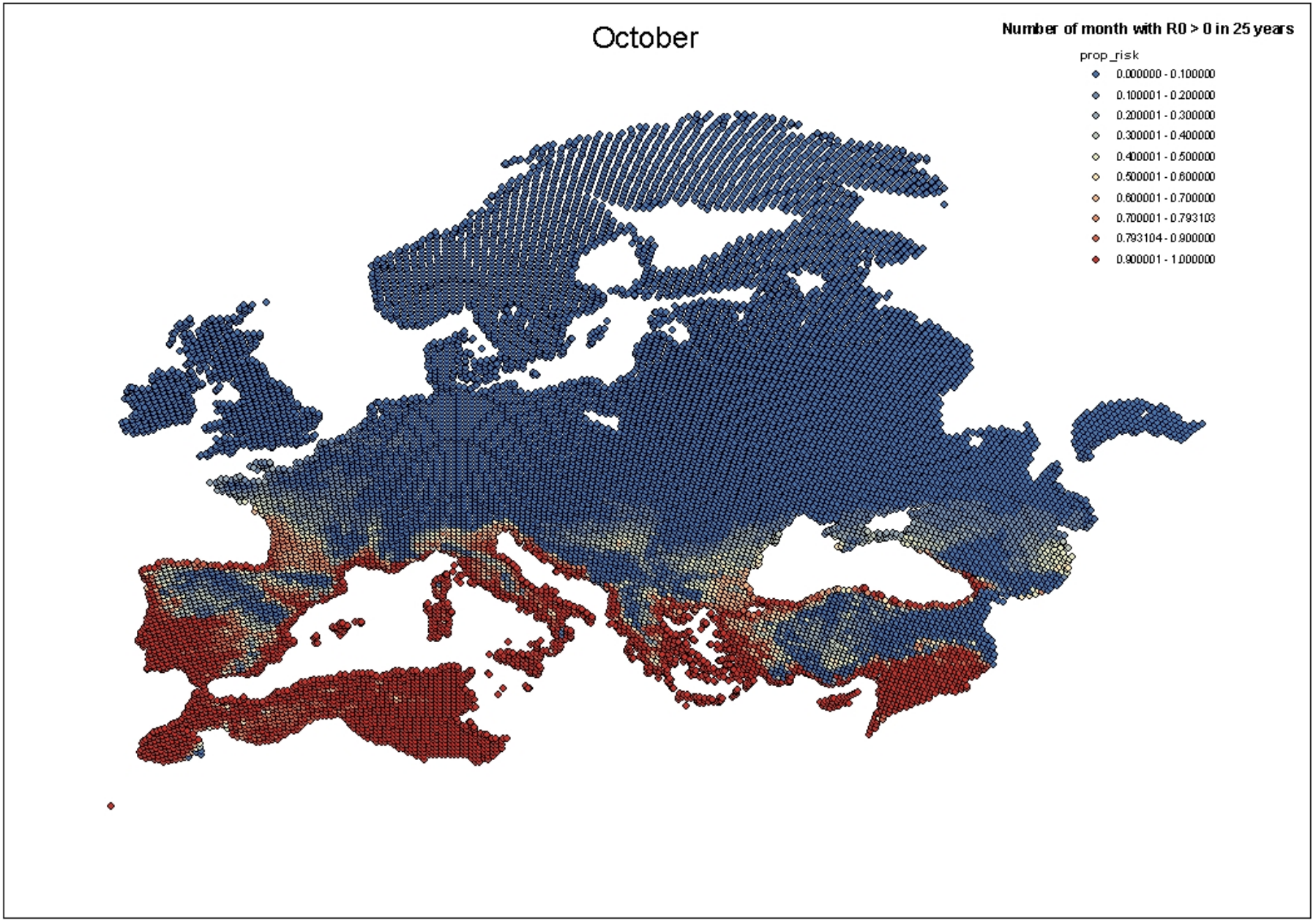
Predicting risk by surveillance of risk factors



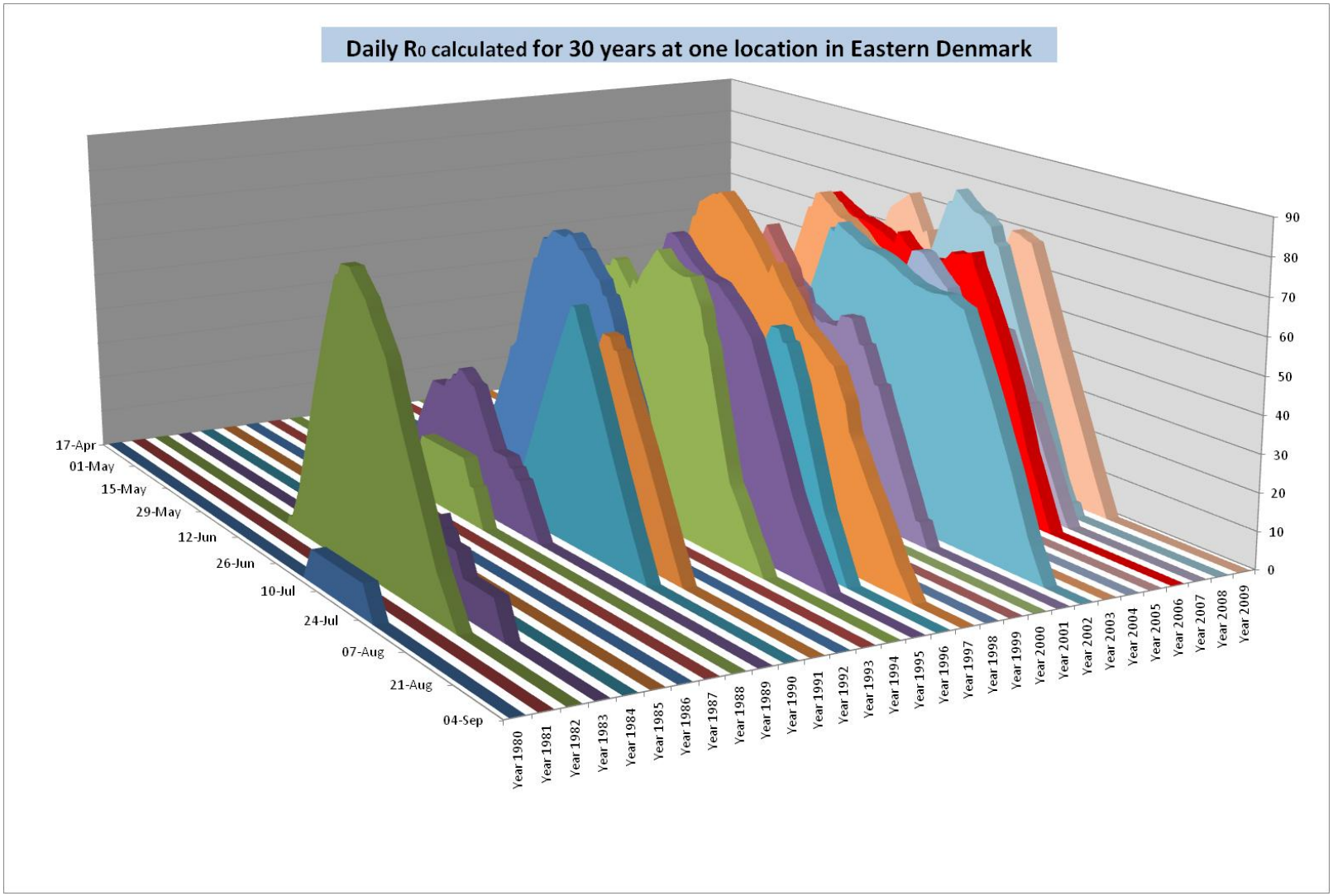
Predicting risk by surveillance of risk factors



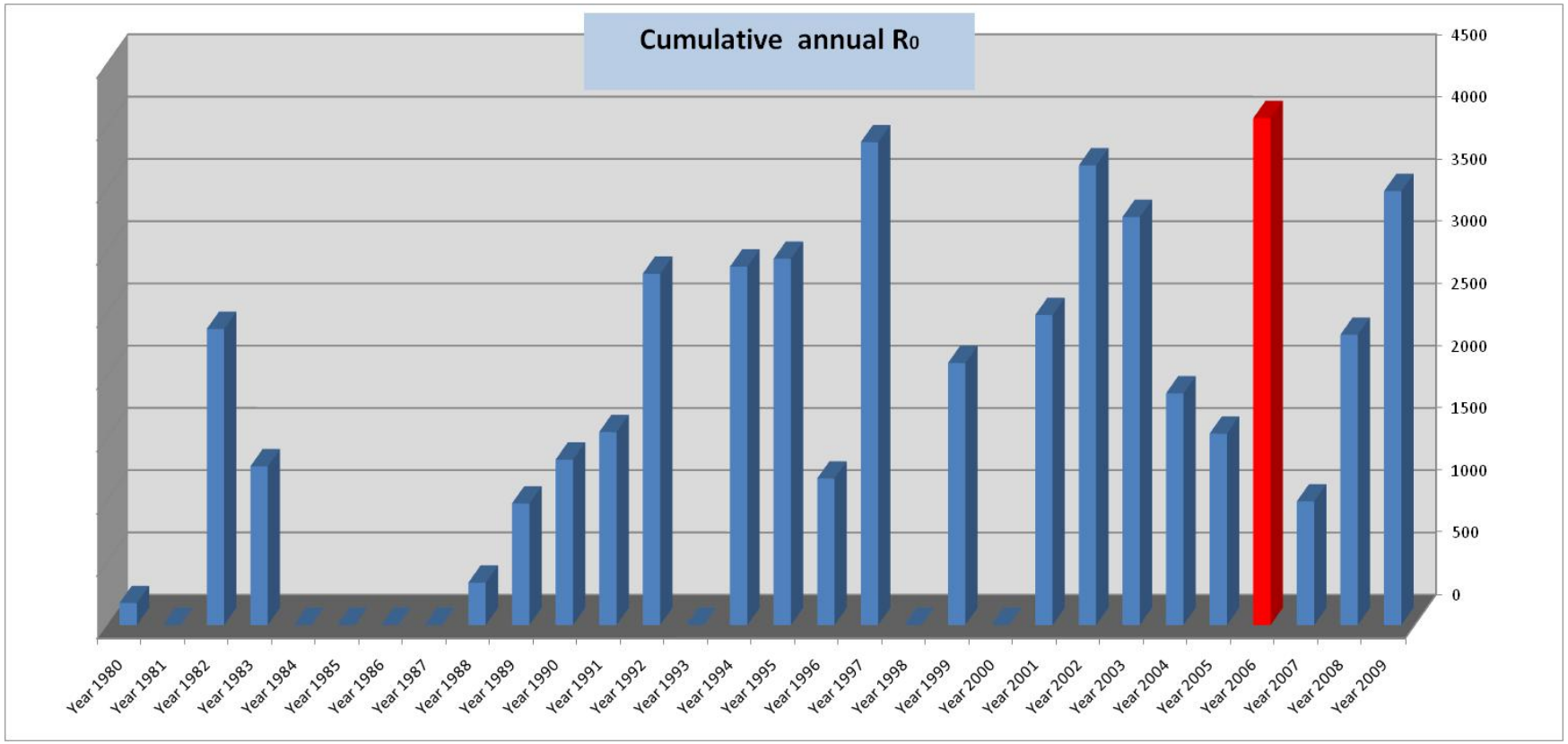
Predicting risk by surveillance of risk factors

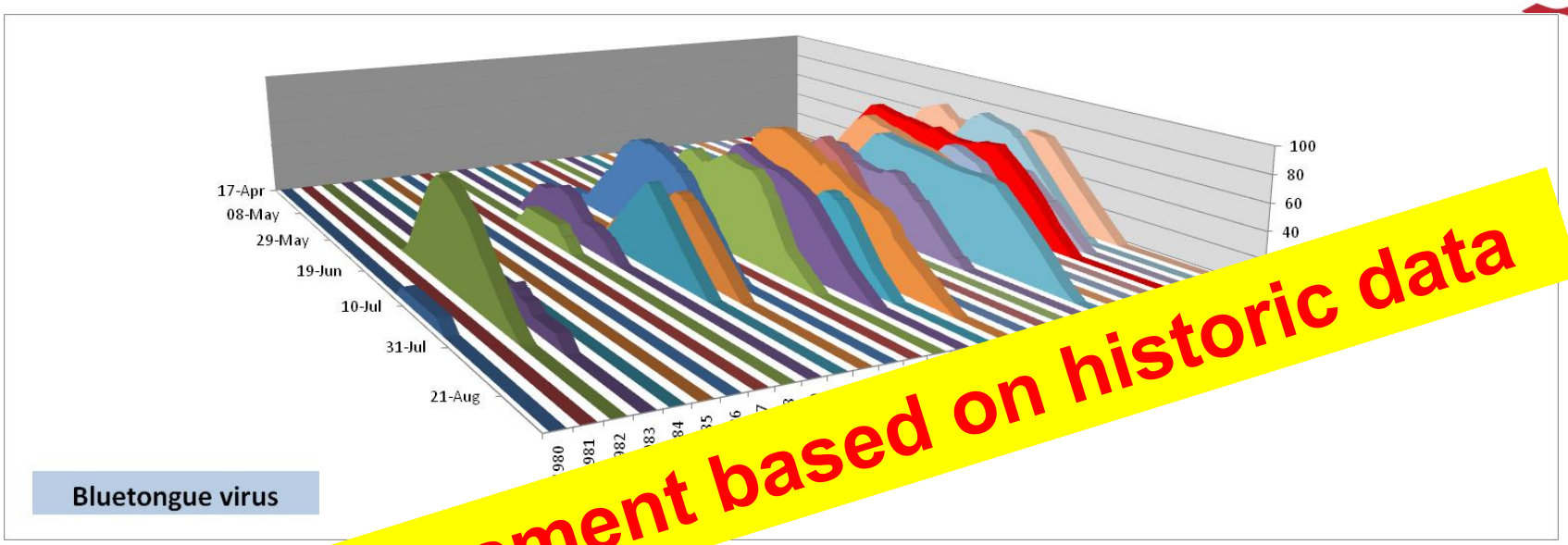


Bluetongue

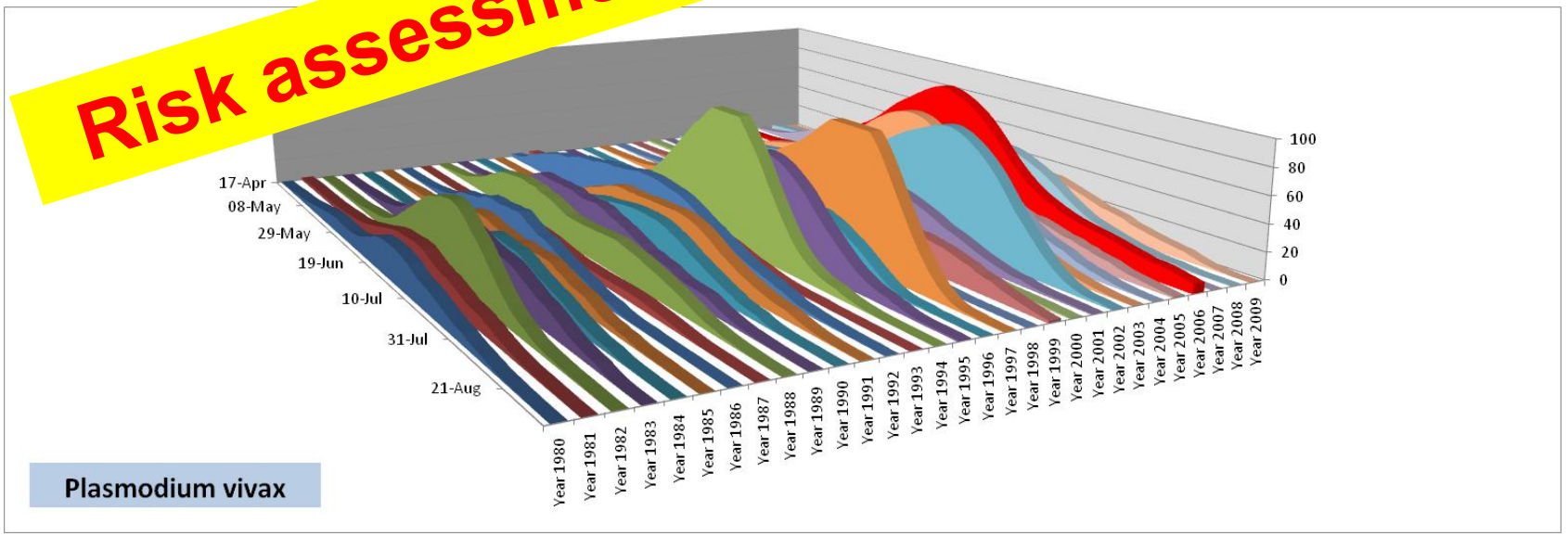

Daily R0 calculated for 30 years at one location in Eastern Denmark
17-Apr
01-May
15-May
29-May
12-Jun
26-Jun
10-Jul
24-Jul
07-Aug
21-Aug
04-Sep
Year 1980
Year 1981
Year 1982
Year 1983
Year 1984
Year 1985
Year 1986
Year 1987
Year 1988
Year 1989
Year 1990
Year 1991
Year 1992
Year 1993
Year 1994
Year 1995
Year 1996
Year 1997
Year 1998
Year 1999
Year 2000
Year 2001
Year 2002
Year 2003
Year 2004
Year 2005
Year 2006
Year 2007
Year 2008
Year 2009
0
10
20
30
40
50
60
70
80
90

Bluetongue


Cumulative annual R0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Year 1980
Year 1981
Year 1982
Year 1983
Year 1984
Year 1985
Year 1986
Year 1987
Year 1988
Year 1989
Year 1990
Year 1991
Year 1992
Year 1993
Year 1994
Year 1995
Year 1996
Year 1997
Year 1998
Year 1999
Year 2000
Year 2001
Year 2002
Year 2003
Year 2004
Year 2005
Year 2006
Year 2007
Year 2008
Year 2009



Risk assessment based on historic data



www.nordrisk.dk

DTU

Nordic Climate Change
Modelling vectorborne diseases

DTU Veterinary
National Veterinary Institute

NordRisk Site Menu

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- Vectors
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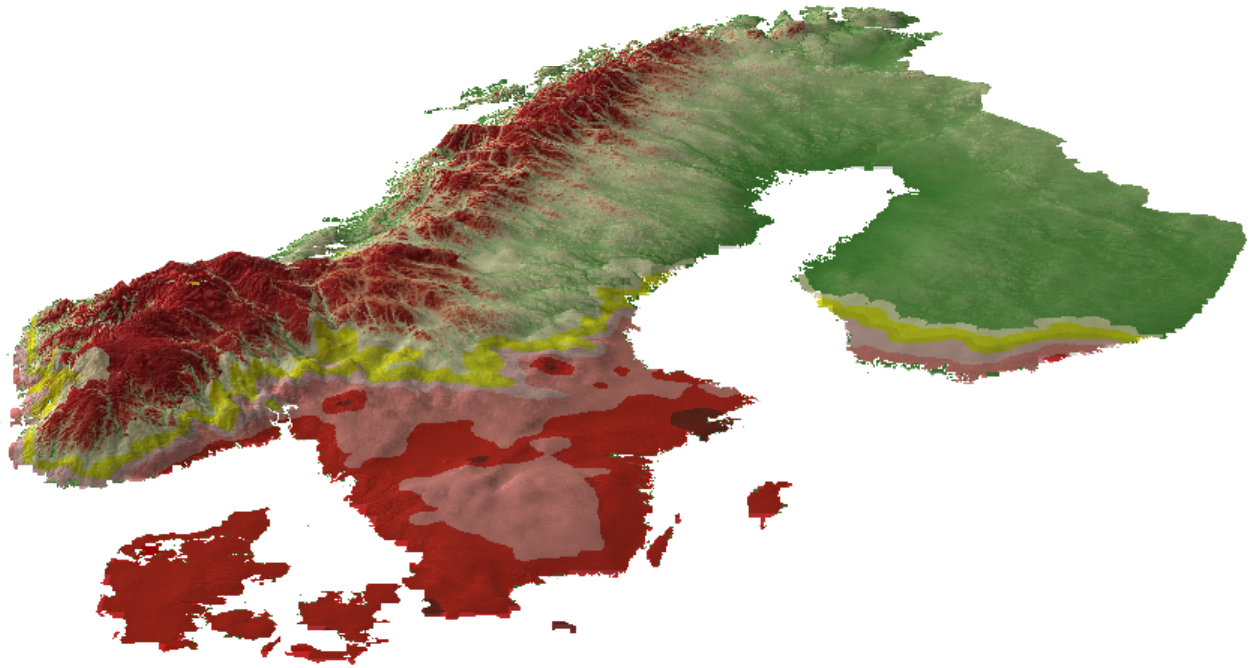
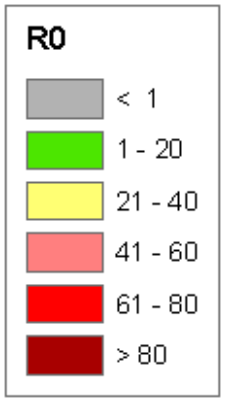
- Climate projections
- Topography
- Demography
- Land use
- Husbandry
- Links
- Contact

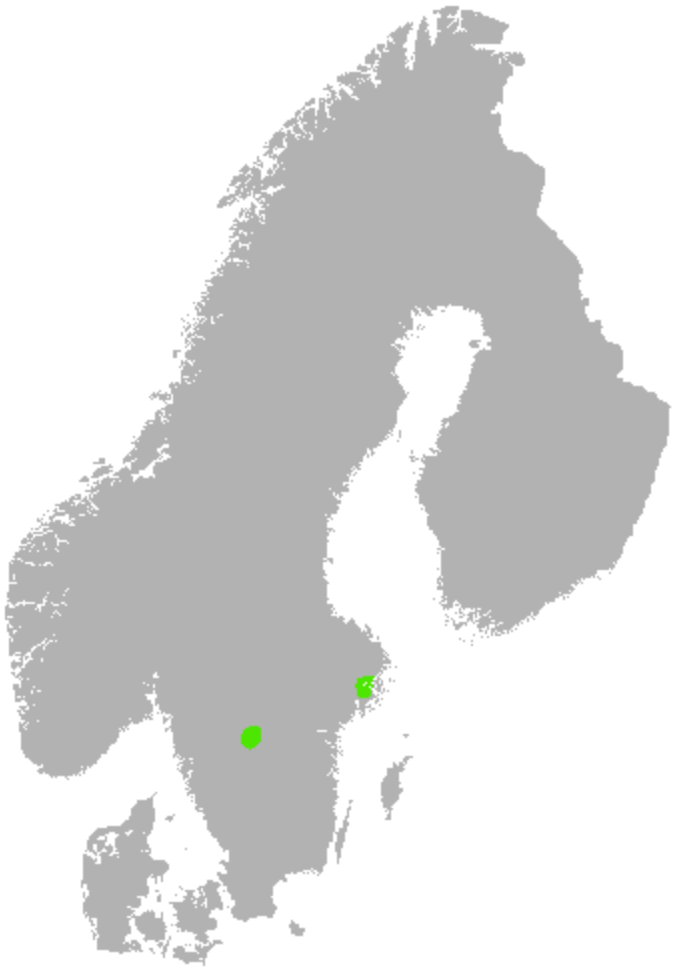


Division of Veterinary Diagnostics and Research
National Veterinary Institute, Technical University of Denmark

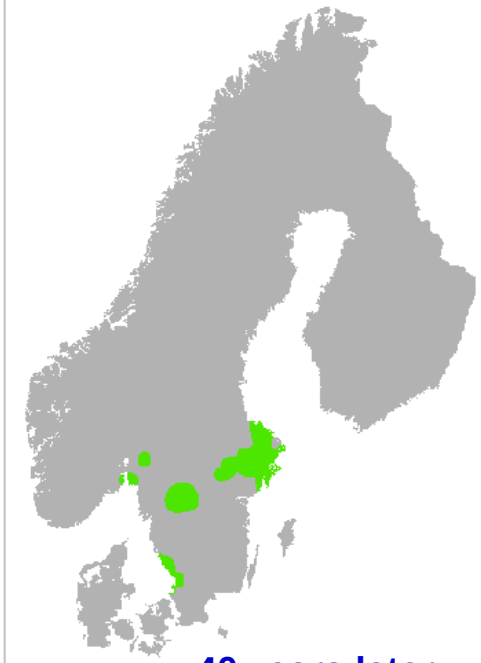
norden
Nordic Council of Ministers

Bluetongue

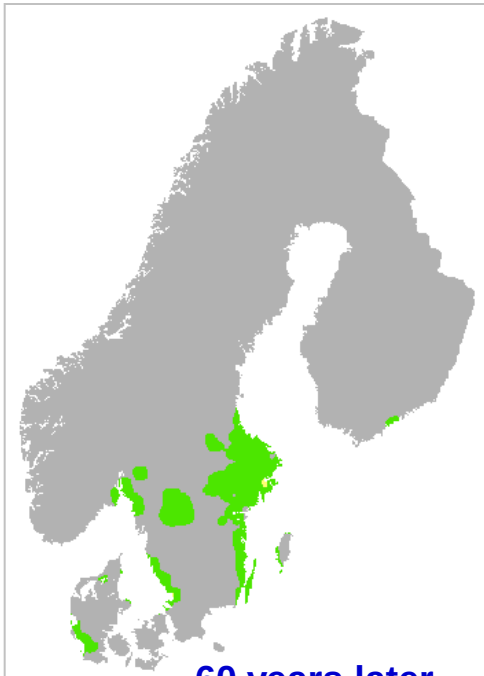




R_0 05 May 2008

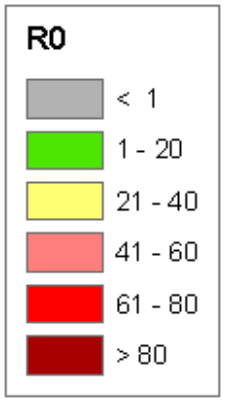


40 years later

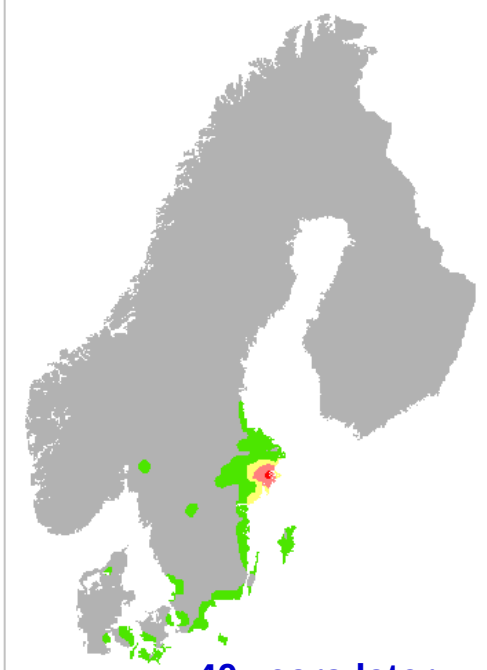


60 years later

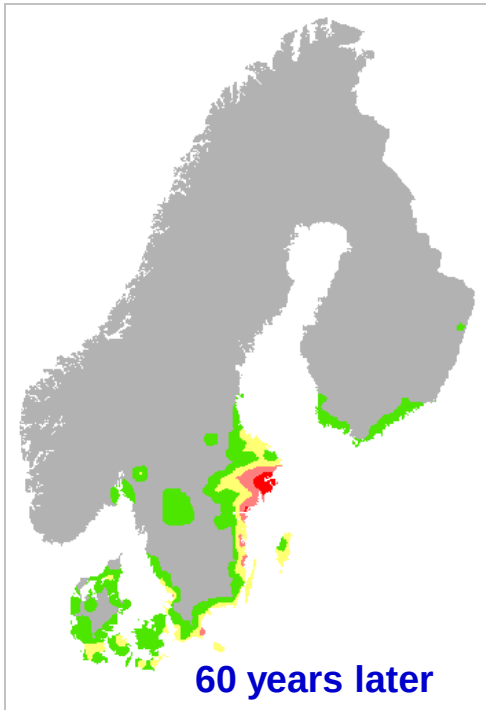
Bluetongue



R_0 02 Jun 2008

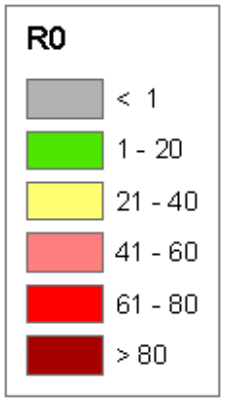


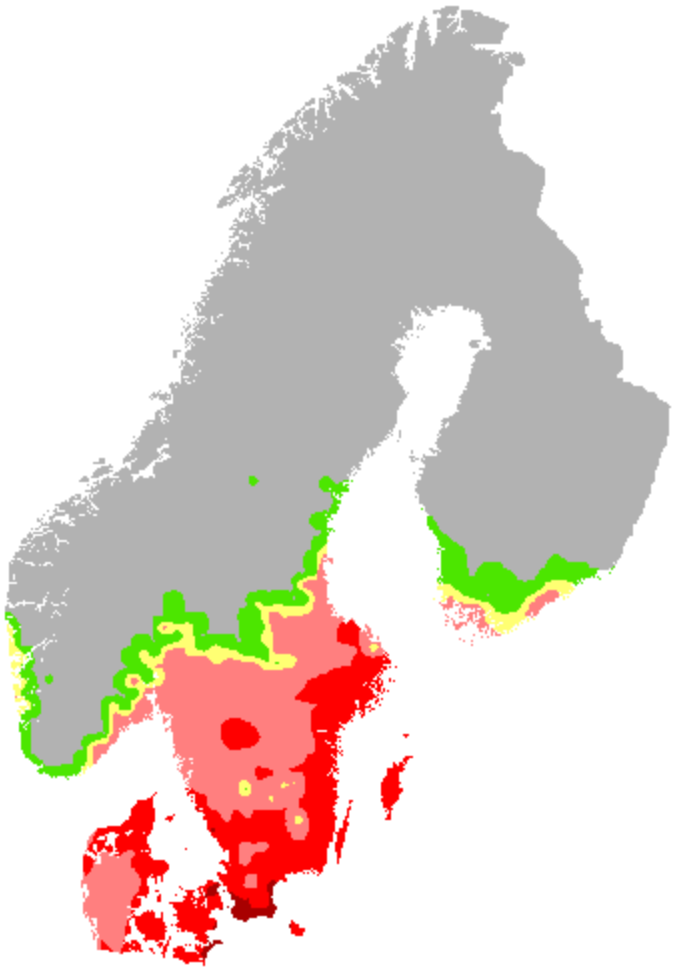
40 years later



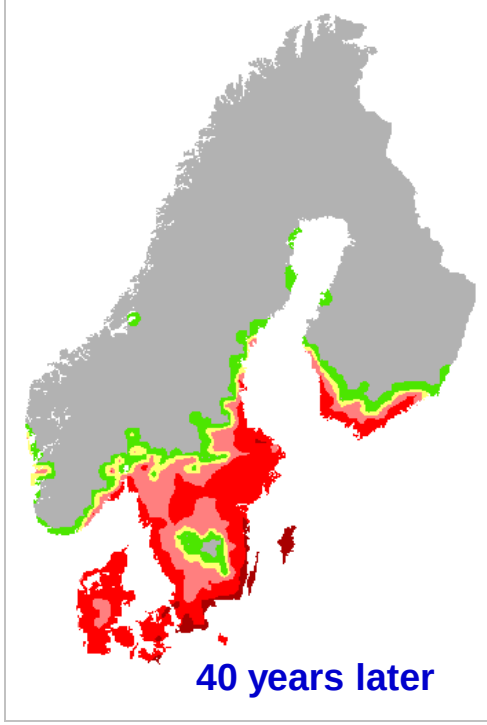
60 years later

Bluetongue

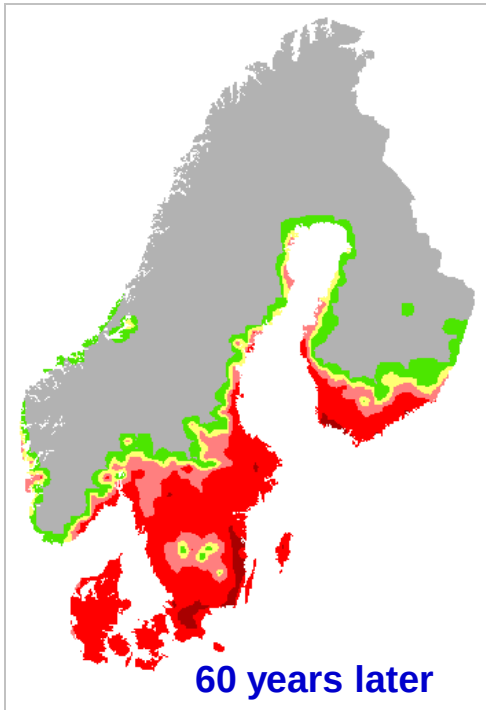




R_0 30 Jun 2008

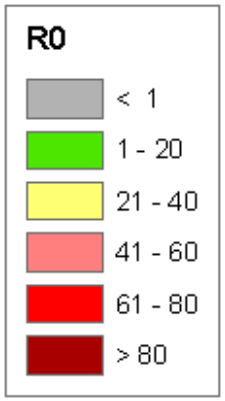


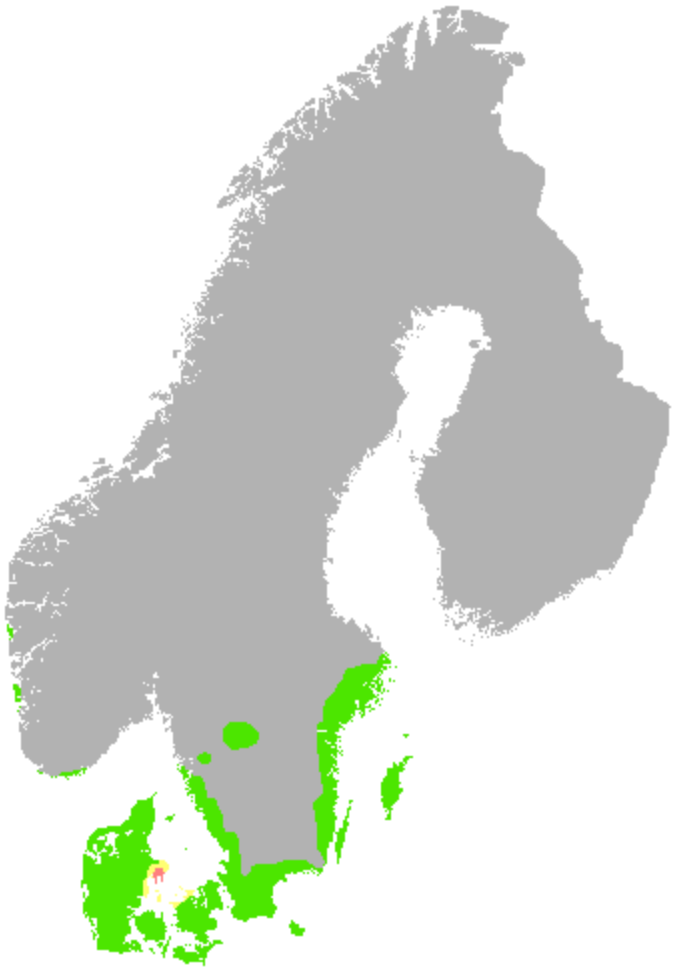
40 years later



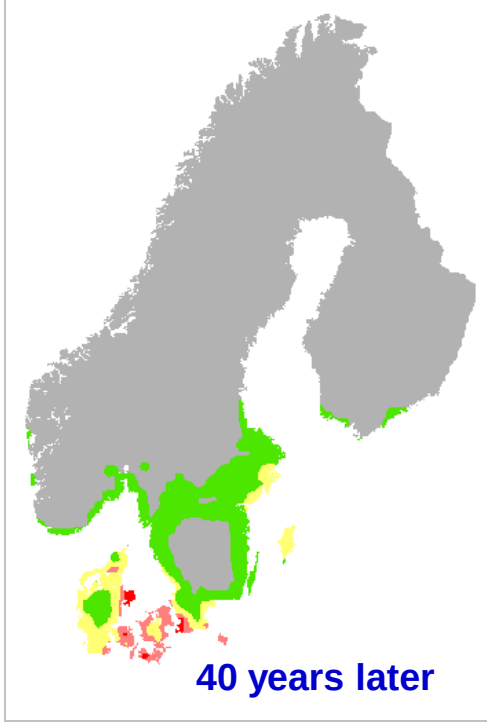
60 years later

Bluetongue

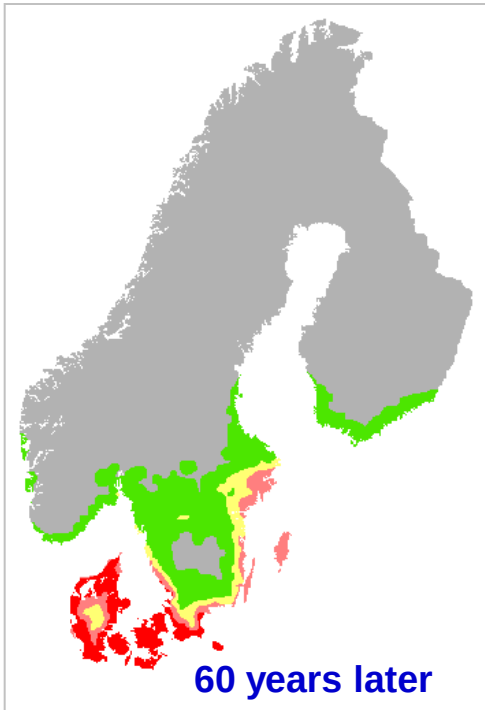




R_0 28 Jul 2008

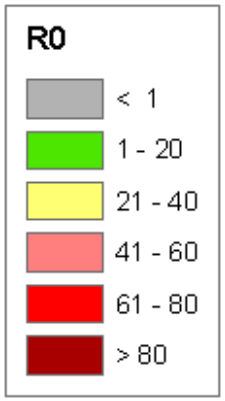


40 years later



60 years later

Bluetongue

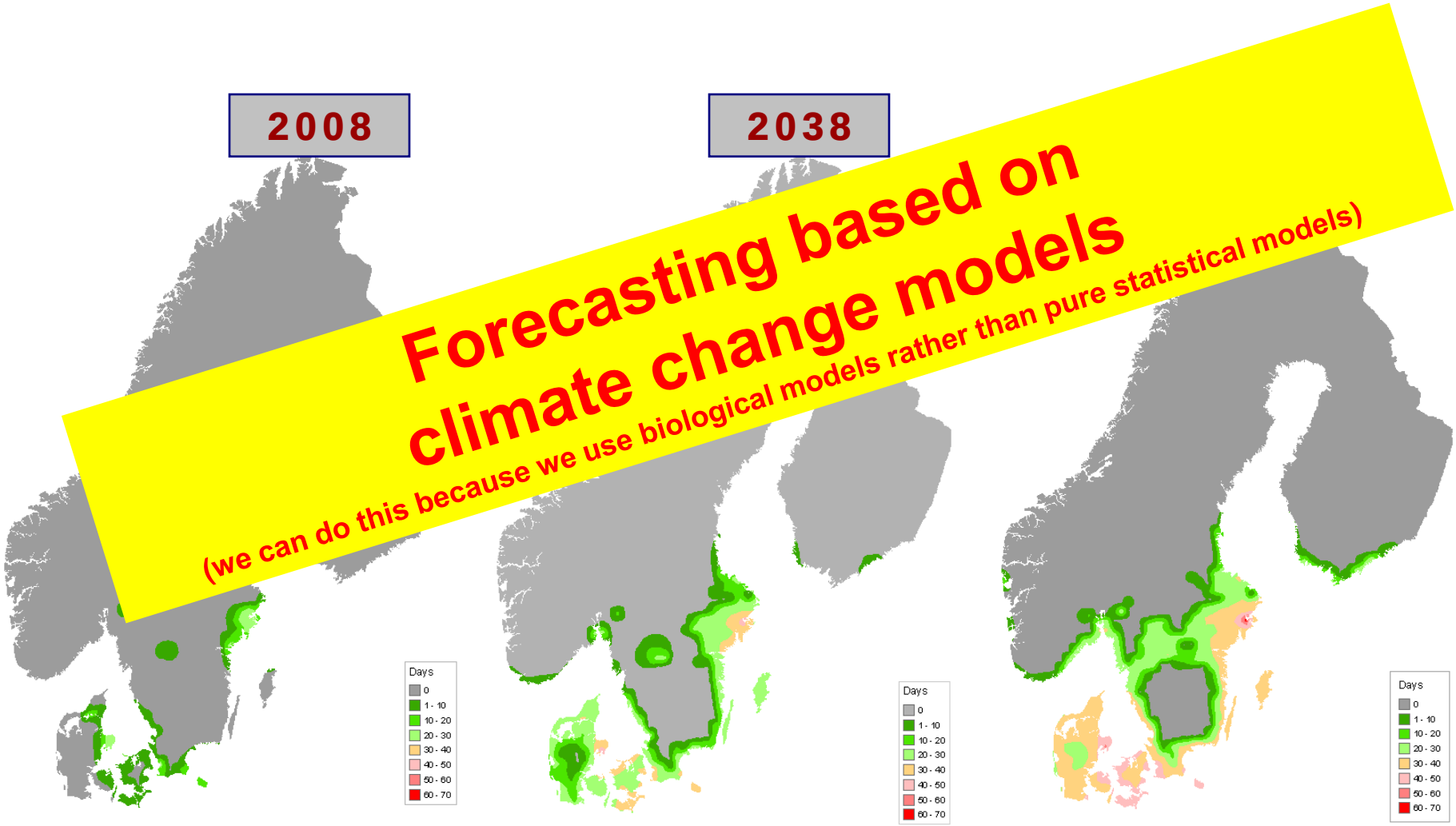


R_0 25 Aug 2008

40 years later

60 years later

Dirofilaria: Annual number of days with infectious mosquitoes

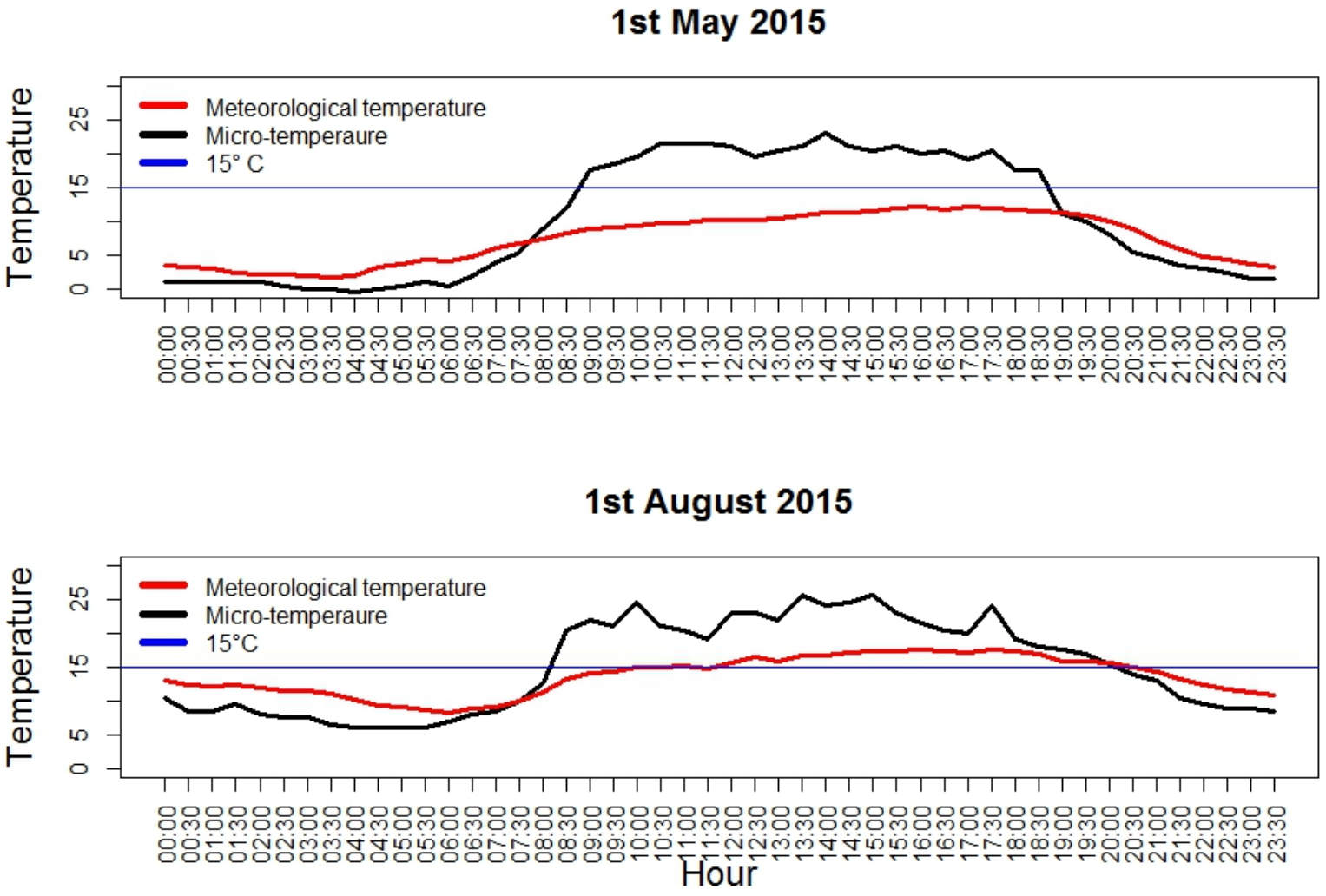


Climate change: Mountain slopes as a proxy for climate change

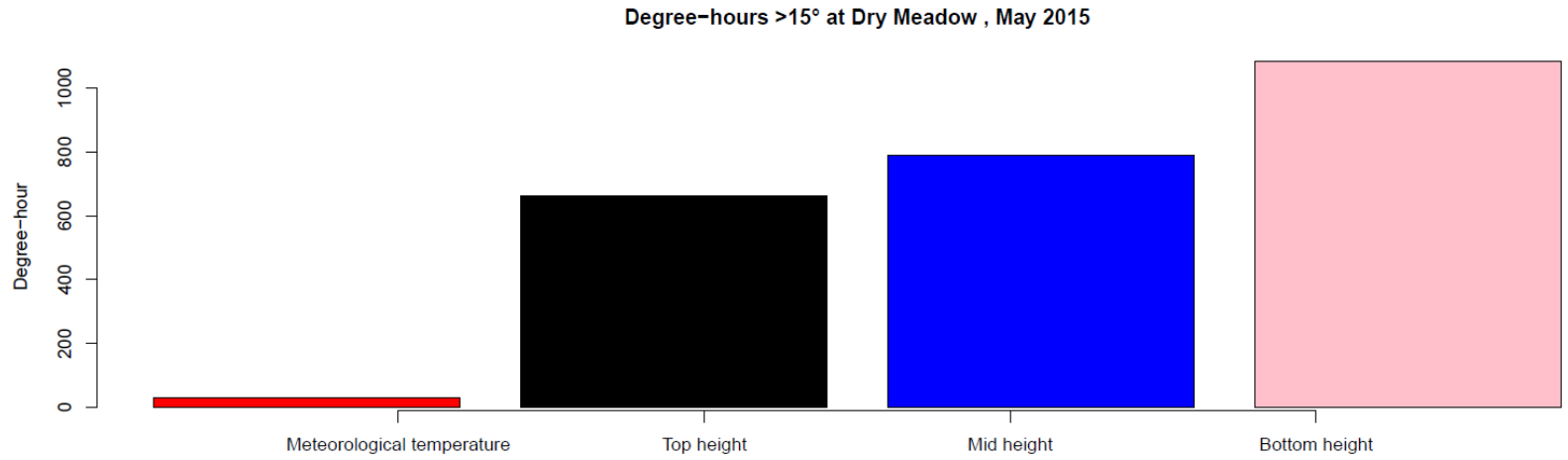
Altitude	Vector density m	$a^2 * p^n / -\ln p$	C	R_0	C ($t = t_{300m}$)	C ($m = m_{300m}$)
300 m	21.1	0.84	11.5	4,206	**11.5**	**11.5**
600 m	3.9	0.55	1.1	417	**1.8**	**6.4**
800 m	1.7	0.45	0.3	120	**0.72**	**4.7**
1000 m	0.3	0.18	0.014	5.2	**0.09**	**1.3**
1400 m	0.06	0.09	0.008	3.0	**0.04**	**0.2**
1700 m	0.01	0.02	0.00002	0.007	**0.004**	**0.02**

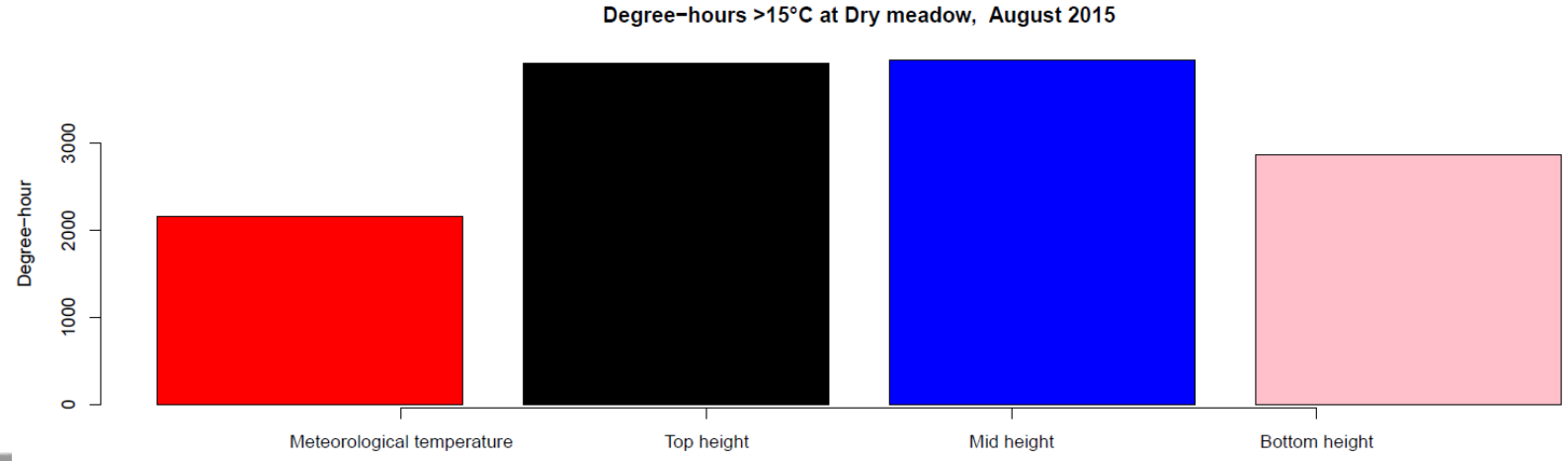
http://www.nordrisk.dk/diro_ani_wait.htm

Micro-climate versus meteorological temperature

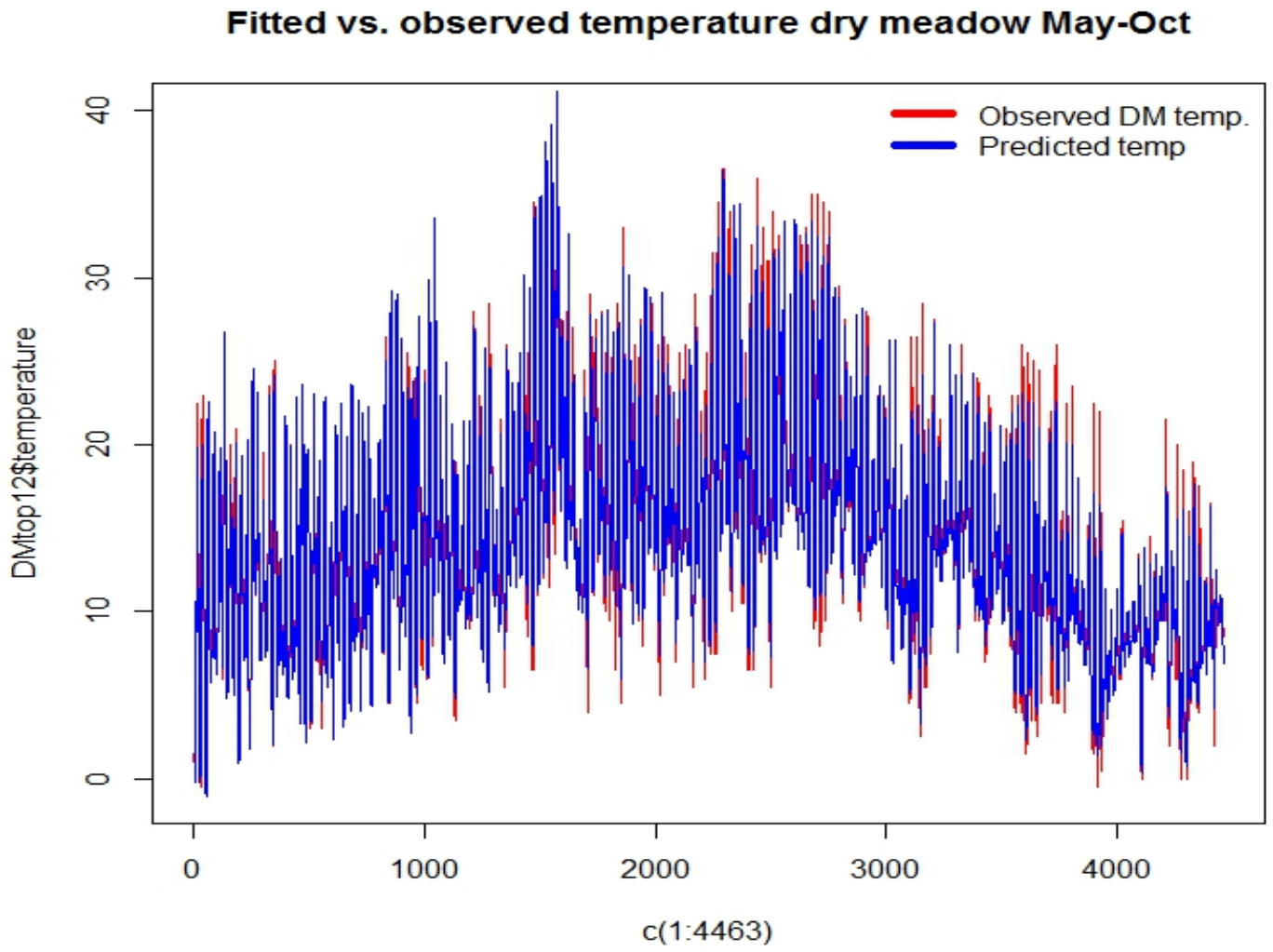


Degree-hours above 15^{0}C

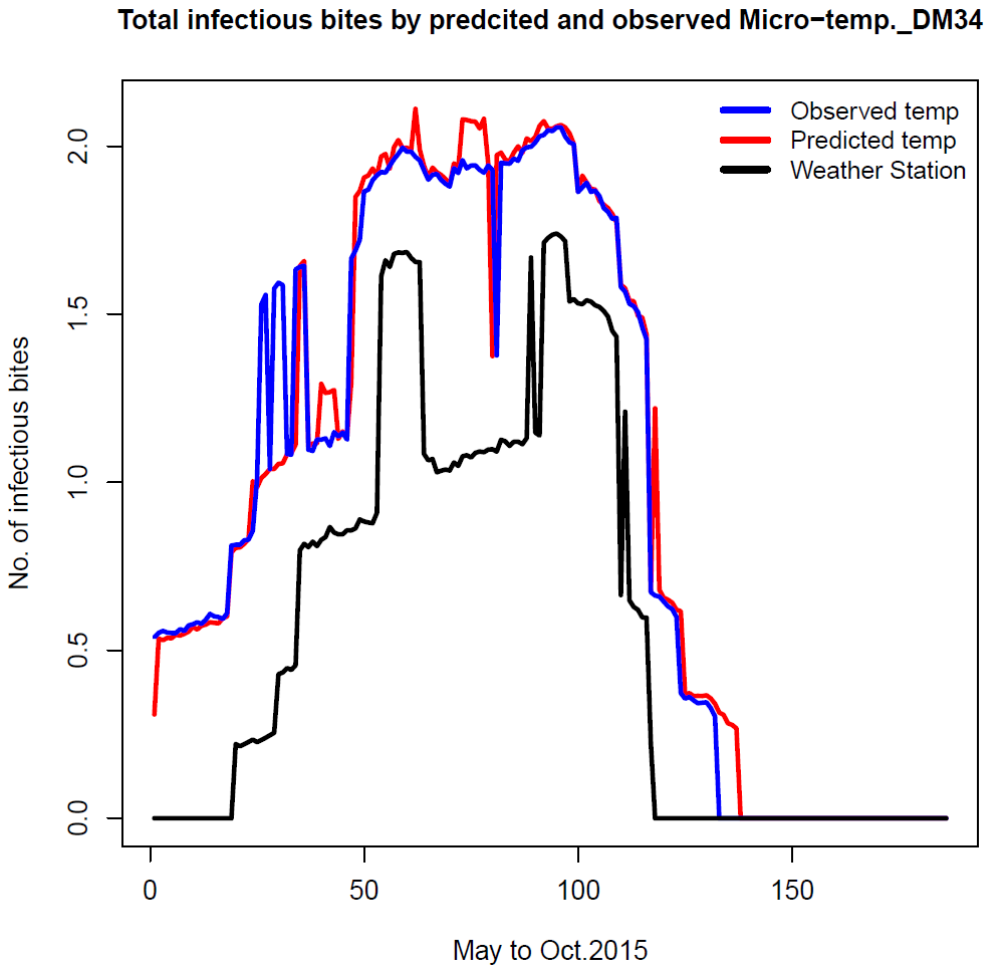




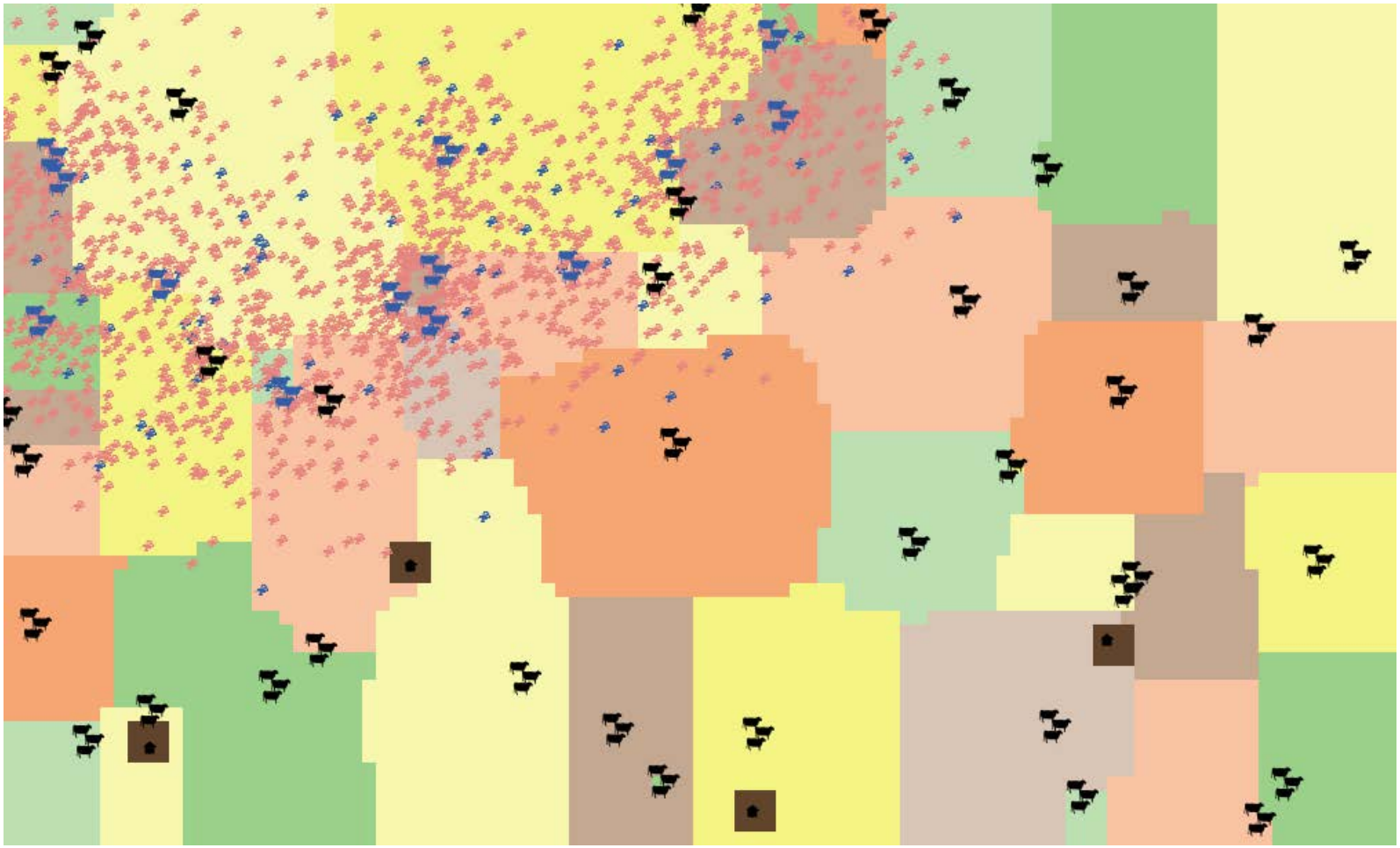
Observed versus predicted microclimate



Infectious bites/culicoides



Model visualization



- If you want to map vectors or even develop a surveillance system for vectors, then first ask yourself what you will do with the data
- Ask yourself how you will make decisions related to human and veterinary health based on your vector data
- Else you risk ending up just mapping mosquitoes and not vectors
- Keep your focus on the diseases
  – mosquitoes and Culicoides are just input variables

Thank you
for your attention

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You are most welcome to contact René Bødker

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www.myggetal.dk

www.nordrisk.dk